C-A FIXED TARGET USERS TRAINING

For Year 2001
Safety Associated With The
Primary and Secondary Experimental Areas
&
Rad Worker II Module For AGS High Radiation Area Training

STUDY GUIDE

December 2000, Rev 02

This training incorporates the following BNL training courses:
Equivalency for:
ODH (0)
Stop Work (GE-Stopwork)
Emergency Planning (GE EMERGPLAN)
High Radiation Module (HP-RWT-400)
ET (HP-V001)

Reciprocity for:
DOE Trained Radiation Worker I (RWT002-REC)

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C-A FIXED TARGET USERS TRAINING

LEARNING OBJECTIVES OR WHY TAKE THIS COURSE?

This Course is required if you want unescorted access into secondary and primary areas associated with AGS experiments. AGS primary areas are often synonymous with High Radiation Areas and thus require you to have facility specific knowledge.

This course covers:

1. the physical design features and administrative controls that are used to prevent accidental exposures in primary areas, and
2. the conventional safety issues normally reviewed in AGS Users Training.

Annual retraining in C-A Fixed Target Users Training is required.

You will learn about the posting and access controls for AGS High Radiation and Very High Radiation Areas. The requirements for entering and working in these areas will be covered. The response to emergencies and the guidelines for control of emergency exposure will also be presented.
A pre-requisite for this course is Radiation Worker 1.

Please be aware that successful completion of this course does not allow you to work in AGS Contamination Areas. Further training in "Contamination Worker" is required.

Successful completion of this course does not allow you to remove activated materials from AGS primary areas and place them in uncontrolled areas without the assistance of HP Technicians.

This course does not cover experiment-specific training such as the g-2 Magnetic Safety Plan. Your Experiment Spokesperson or Liaison Physicist is responsible for ensuring the collaboration is qualified in experiment specific training.

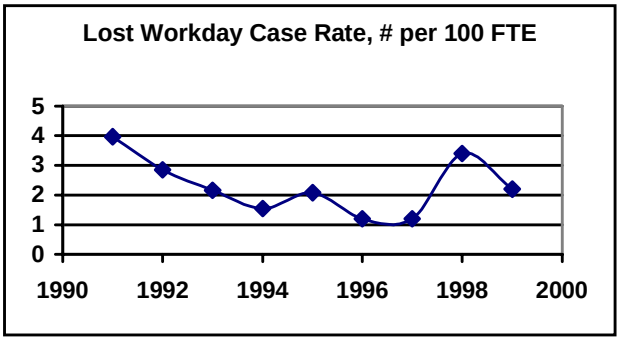
Question: if an area is improperly entered; for example, by climbing over a shield block or by slipping through a hole in a gate, could you be killed by direct exposure to the beam?

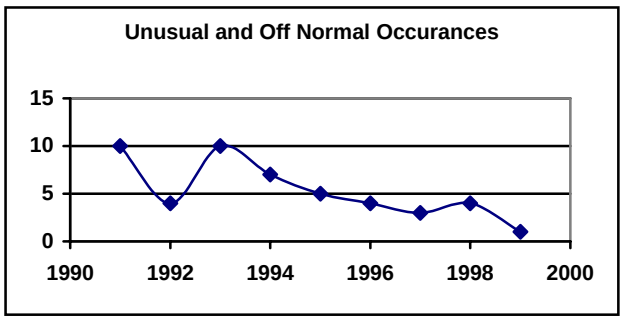
Answer: yes. The beam is intense enough to deliver a lethal dose.

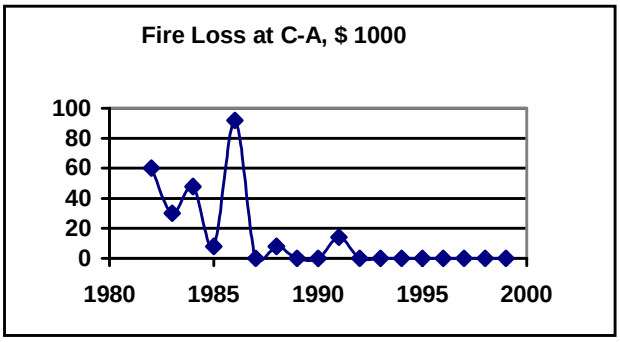
In addition to ionizing radiation hazards, primary areas and experimental areas may contain hazards posed by:

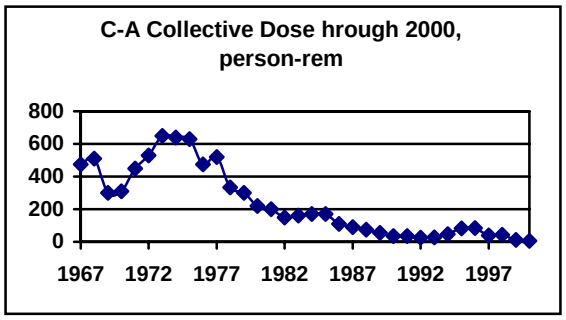
1. heavy objects,
2. mechanical equipment,
3. overhead cranes,
4. heights,
5. high magnetic fields,
6. hot and cold surfaces,
7. steam,
8. high-voltage and high-current electrical systems,
9. noise hazards,
10. radio frequency radiation, and
11. contamination and oxygen deficiency .

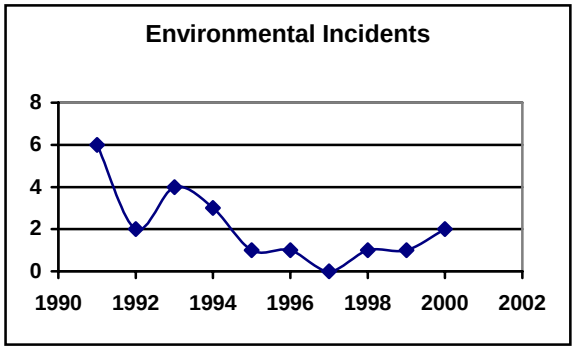
We strive to maintain an excellent safety record in such a complex environment without undue inconvenience to the AGS Users. With your help, over the last few years we have significantly reduced fire losses, radiation dose, unusual occurrences, environmental releases and injuries.











We can assure the continuity of this safety record only by having the active cooperation of each individual who has access to the primary and secondary experimental areas. Each of you should familiarize yourselves with all applicable safety regulations and experiment procedures.

WARNING:

Willful or flagrant disregard of Federal radiation-protection rules may result in disciplinary action, monetary penalties, and / or criminal prosecution.

Question: does C-A Fixed Target User's Training, the training given here, permit you to work in a primary area that is also a Contamination Area?

Answer: no. In order to work in a primary area that is also a Contamination Area, you must be trained in Contamination Worker Training.

RESEARCH SUPPORT SERVICES

A Liaison Engineer is assigned to coordinate and assist in the setting up and running of the experiment. Your Liaison Engineer is the primary contact for the experimental team during the construction phase. The engineer will make a detailed design layout of the experiment, including a time estimate, and will arrange for rigging, survey, safety reviews, and such requirements as electrical work, plumbing, carpentry and air conditioning. Items that require a safety review or other advance approvals are listed in C-A Operations Procedure Manual (OPM), Chapter 9. After the experiment is running, all operating problems are handled by the Facilities and Experimental Support Group (F&ES) Watch. The Liaison Engineer must be consulted regarding special requirements or modification of the experimental set-up.

A Liaison Physicist is assigned to your experiment. The Liaison Physicist is a consultant to the Liaison Engineer. The Liaison Physicist is your primary contact for safety-related information associated with your experiment. Generally, the Liaison Physicist is responsible for a specific target station as well as the experiments. Your Liaison Physicist provides expert assistance in beam tuning during the first stage of a beam turn-on. He also optimizes the beam during sharing conditions. He should be consulted to help solve ionizing radiation problems, and to solve other problems of this general safety character.

An Experimental Spokesperson is a person who will act on behalf of all the collaborators on the experiment. His/her specific safety responsibilities are as follows:

- Experiment Spokespersons are responsible for all transient personnel visiting the experiment. The Experiment Spokesperson must ensure that visitors are wearing the appropriate TLD badges or dosimeters, and that visitors are escorted by a person who is thoroughly aware of the hazards and safety requirements. C-A OPM 2.16 provides requirements for escorts.

- Experiment Spokespersons are responsible for ensuring that all personnel involved with the experiment apparatus are trained in the emergency procedures, and other safety-related procedures assigned by the AGS Safety Committees. These procedures may be associated with mixing flammable gases, moving protective shields into place or enforcing magnetic safety plans.

- Experiment Spokespersons are responsible for ensuring that the experiment as a whole and certain types of equipment, such as pressure vessels and cryostats, are not operated before undergoing appropriate safety reviews. The Experiment Spokesperson must inform the Liaison Physicist prior to the introduction of a new hazard. Sufficient time must be allowed for review of modifications prior to planned operations.

- Experiment Spokespersons are responsible for ensuring radioactive sources are inventoried and leak checked as required by Federal Law. The Experiment Spokesperson is the person responsible for all radioactive sources brought into the AGS, no matter the size

of the source or the origin of the source. That is, even if the source comes from another BNL Department, THEN it must be inventoried at C-A. These sources are typically used to calibrate or check the response of experimental detectors. The Experimental Spokesperson shall ensure the source is checked by HP (x4660) for leakage every six months, and he/she shall enforce the C-A Sealed-Source Inventory Procedure. Source inventory forms are available in the C-A Training Office.

- It is an Experiment Spokesperson's responsibility to ensure that all work by the collaboration is properly planned and reviewed for ES&H issues.

After the reviews by appropriate C-A safety committees, the Liaison Physicist, Liaison Engineer and the Experiment Spokesperson are made aware of safety requirements for your experiment. Either the Liaison Physicist, Liaison Engineer, or the Experiment Spokesperson can provide safety information specific to your experiment, however, the **Liaison Physicist** should be considered your primary contact.

Question: who is the primary contact for safety information regarding a modification to your experiment?

Answer: the Liaison Physicist.

C-A CONTACTS LISTS

The following list of contacts provides you with a brief reference, which should be placed near your telephone in the experimental areas. Additionally, a listing of Liaison Physicists, Liaison Engineers and Experimental Spokespersons is given for FY2001 running period.

C-A CONTACTS LIST	EXT.
Building Manager 912	2046
Building Manager 919	2745
C-A Associate Chair for Safety	4250
C-A Department Chair	4611
C-A ES&H Coordinator	4617
C-A ES&H Coordinator	7200
C-A ESHQ Division Head	5272
Environmental Coordinator	7520
F&ES Maintenance Coordinator	2046
F&ES Watch	2042
g-2 Control Room	3627
Health Physics Office at C-A	4660
Main Control Room	4662
Operations Coordinator	4662
Safety Inspection	7934
Security Access Controls Group	2053
Training Manager	7343
Training Office	7007

C-A ESHQ Division Web:
http://www.rhichome.bnl.gov/AGS/Accel/SND/

C-A Department F&ES Division Assignments

FACILITIES	LIAISON ENGINEER	LIAISON PHYSICIST
AGS Experiments:		
E821 (g-2), Spokesperson: Huges/Morse/Robert x4498	J. Scaduto	G. Bunce
E955 (Proton Radiography) Spokesperson: M. Murrey	J. Scaduto	R. Prigl
E957 (NASA Radio-biology Station) Spokesperson: M. Vazquez x3443	D. Phillips/W.McGahern	D. Lazarus
E949 Spokesperson: S. Kettell x5323	A. Pendzick	I-H Chiang
E951 (Muon Collider) Spokesperson: S. Kettell x5323	J. Scaduto	R. Prigl
Other U-line Experiments	A. Pendzick	

FACILITIES	LIAISON ENGINEER	LIAISON PHYSICIST
Other:		
Scheduling Physicist	T. Satogata	
Radiation Protection Physicist	A. Stevens	

Future Experiments:		
D6/E923 (K+->mu3)	C. Pearson	A. Carroll
C6/E927 (Nefkens/Kycia)	J. Scaduto	R. Prigl
D6/E930 (Ge Ball)	C. Pearson	P. Pile
C6/E931 (Delta(I)=1/2)	J. Scaduto	R. Prigl
C4/E926 (Littenberg, Zeller)	C. Pearson	D. Lazarus
C3/E938 (Neutron Spallation, Hastings)	A. Pendzick	A. Carroll
B5/E940 (MECO, Molzon)	D. Phillips	W. Meng
V1/Muon Electric Dipole	D. Lazarus	

FACILITIES	LIAISON ENGINEER	LIAISON PHYSICIST
Engineering & Support		
SNS Installation	A. Pendzick/C. Pearson	W. Weng
SNS Prototype Magnets	C. Pearson	W. Weng/W. Meng
BAF	A. Pendzick/C. Pearson	R. Prigl/W. Meng/I-H Chiang
CAS	D. Phllips	
Experimental PLC's	D. Phillips	
Instrumentation	D. Gassner	I-H Chiang
Beam Lines:		
Switchyard	A. Pendzick	K. Brown
ATR	D. Phillips	N Tsoupas/A. Carroll
V	C. Pearson	N Tsoupas/A. Carroll
U-line	J. Scaduto	N Tsoupas/A. Carroll
Target Stations & Secondary Beam Lines:		
A	J. Scaduto/D. Phillips	R. Prigl
A1	J. Scaduto	G. Bunce
A3	A. Pendzick	D. Lazarus
B	D. Phillips	W. Meng
B1	A. Pendzick	A. Carroll
B2	A. Pendzick	A. Carroll

FACILITIES	LIAISON ENGINEER	LIAISON PHYSICIST
B5	J. Scaduto	A. Carroll
C	Scaduto/Phillips/Pearson	I-H Chiang
C1	C. Pearson	A. Carroll
C3	J.Scaduto	I-H. Chiang
C4	A. Pendzick	I-H. Chiang
C5	D. Phillips	W-Z. Meng
C6	J. Scaduto	R. Prigl
C8	J. Scaduto	R. Prigl
D	C. Pearson	P. Pile
D2	C. Pearson	I-H. Chiang
D6	C. Pearson	P. Pile
FEB	D. Phillips	N. Tsoupas
U	J. Scaduto	R. Prigl
Muon Storage Ring	A. Pendzick	G. Bunce
V	C. Pearson	G. Bunce
V Target	C. Pearson	G. Bunce
V1	C. Pearson	W. Meng

BNL USER CENTER

The RHIC & AGS Users' Center is located in building 355A, telephone 631-344-5975, or e-mail userscenter@bnl.gov. All users are required to check in and out at the Users' Center.

During the check in process you will be familiarized with Brookhaven's commitments and obligations to its visiting population as well as BNL's expectations and requirements for individuals visiting the laboratory.

The checking out process at Brookhaven is very important. When you leave the laboratory, this formal procedure addresses such issues as radiation badges, access cards, library books, experimental equipment and supplies, decommissioning of experiments, and shipping equipment and materials back to your home institution.

EXPERIMENTAL FACILITIES DESCRIPTION

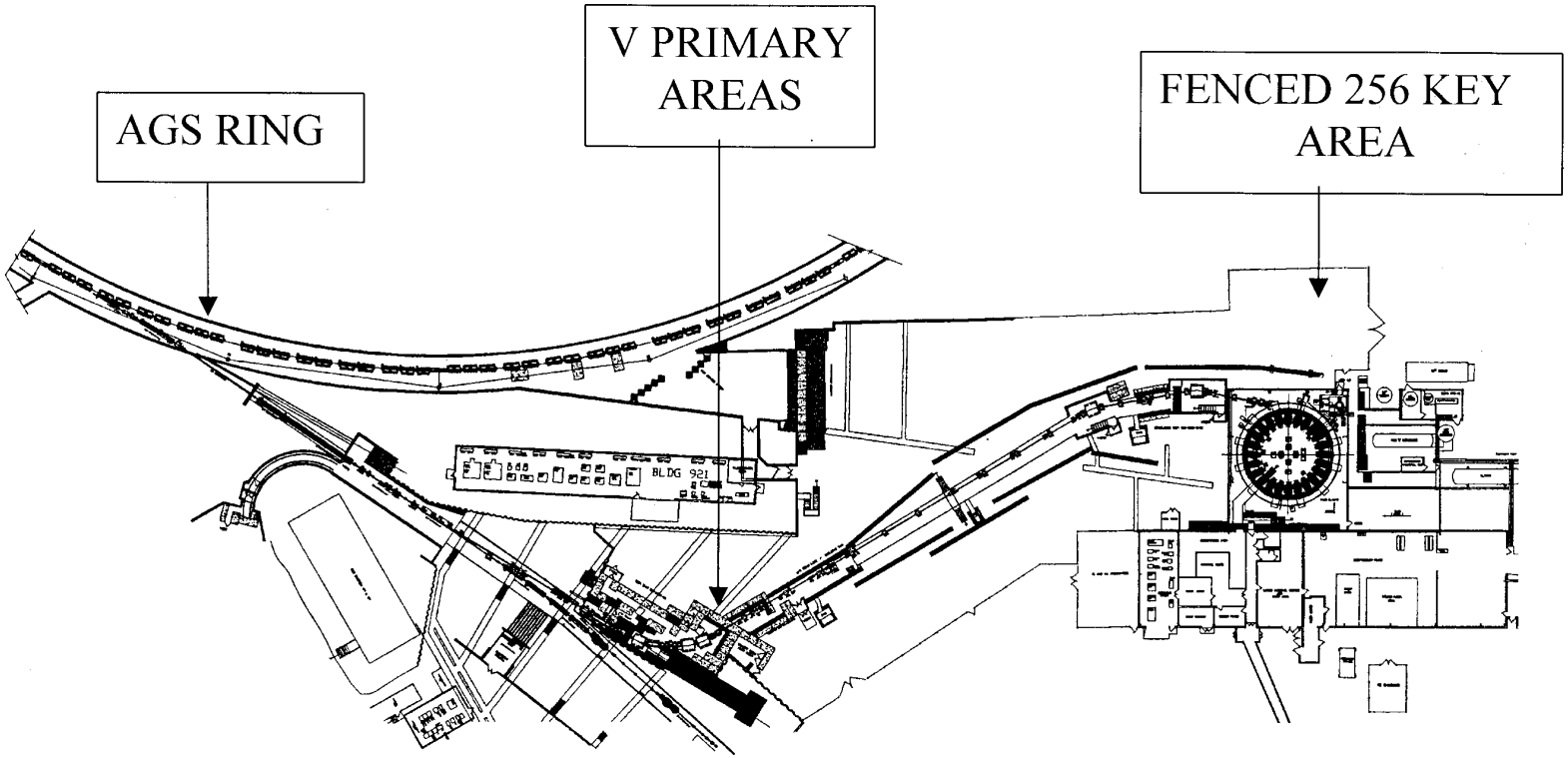
PRIMARY AREAS are areas where beam is fully enclosed. For experimental areas at this time, this includes:

1. the muon storage ring, g-2,
2. the A line, and
3. the U line.

Primary areas include the tube-like enclosures that directly surround the beam whenever it traverses the experimental areas.

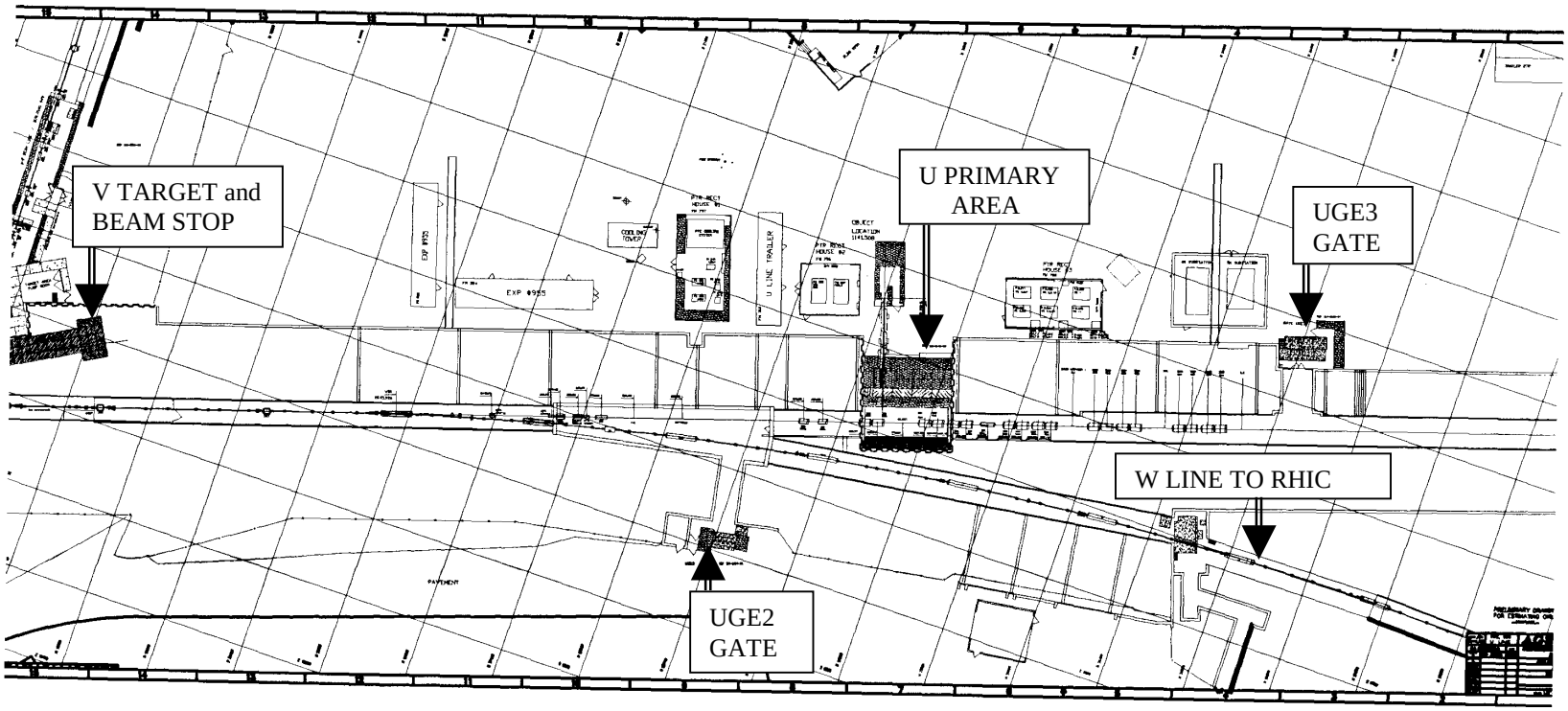
Primary areas are fully enclosed by shielding or fences and have a barrier on the roof. With the exception of tube-like structures for heavy ion beams, they are generally arranged as shielded areas with interlocked gates.

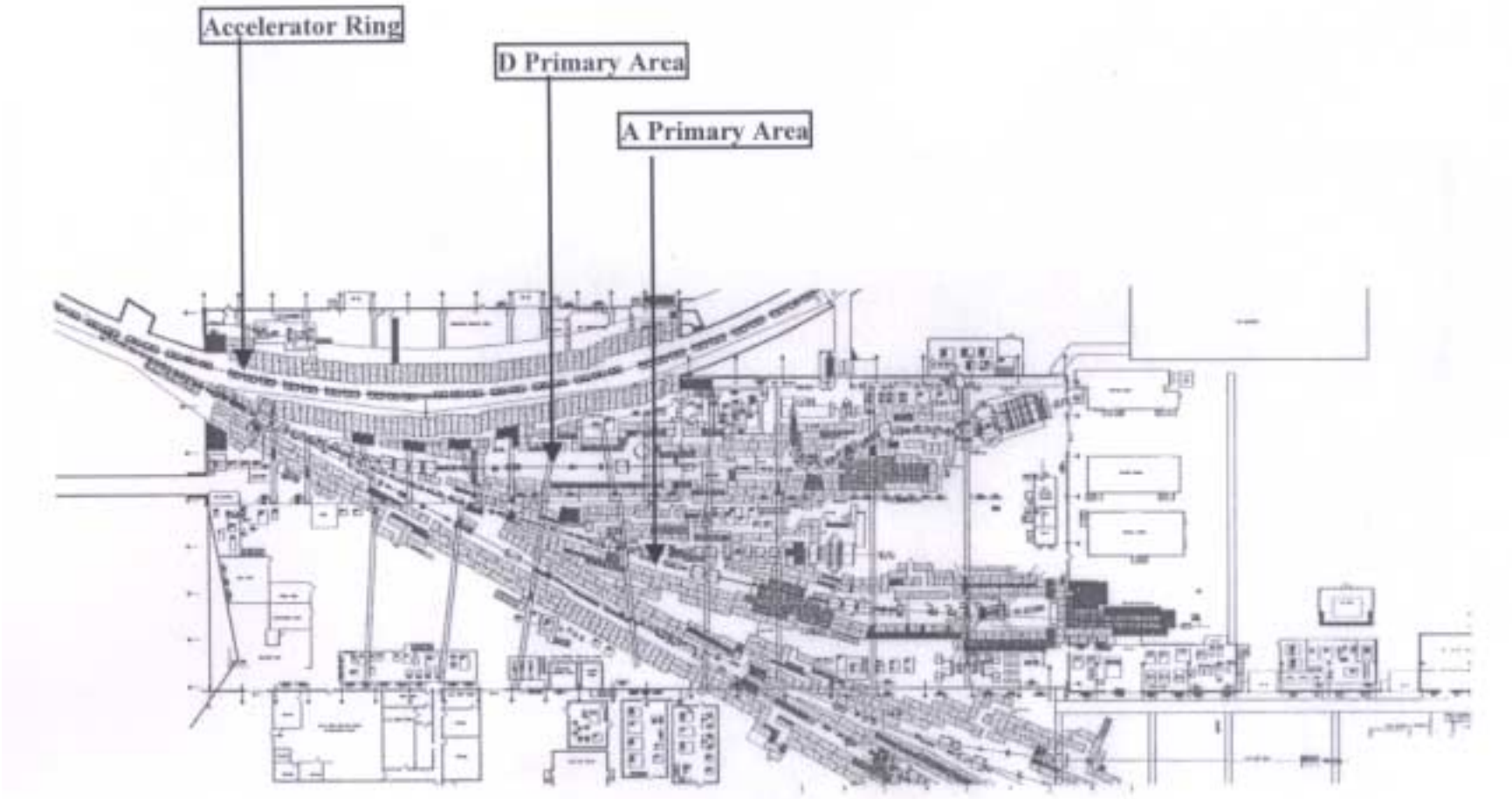
Several views of AGS experimental areas that are also primary areas are given on the following pages. The overall radiological areas that surround the AGS complex is also pictured.



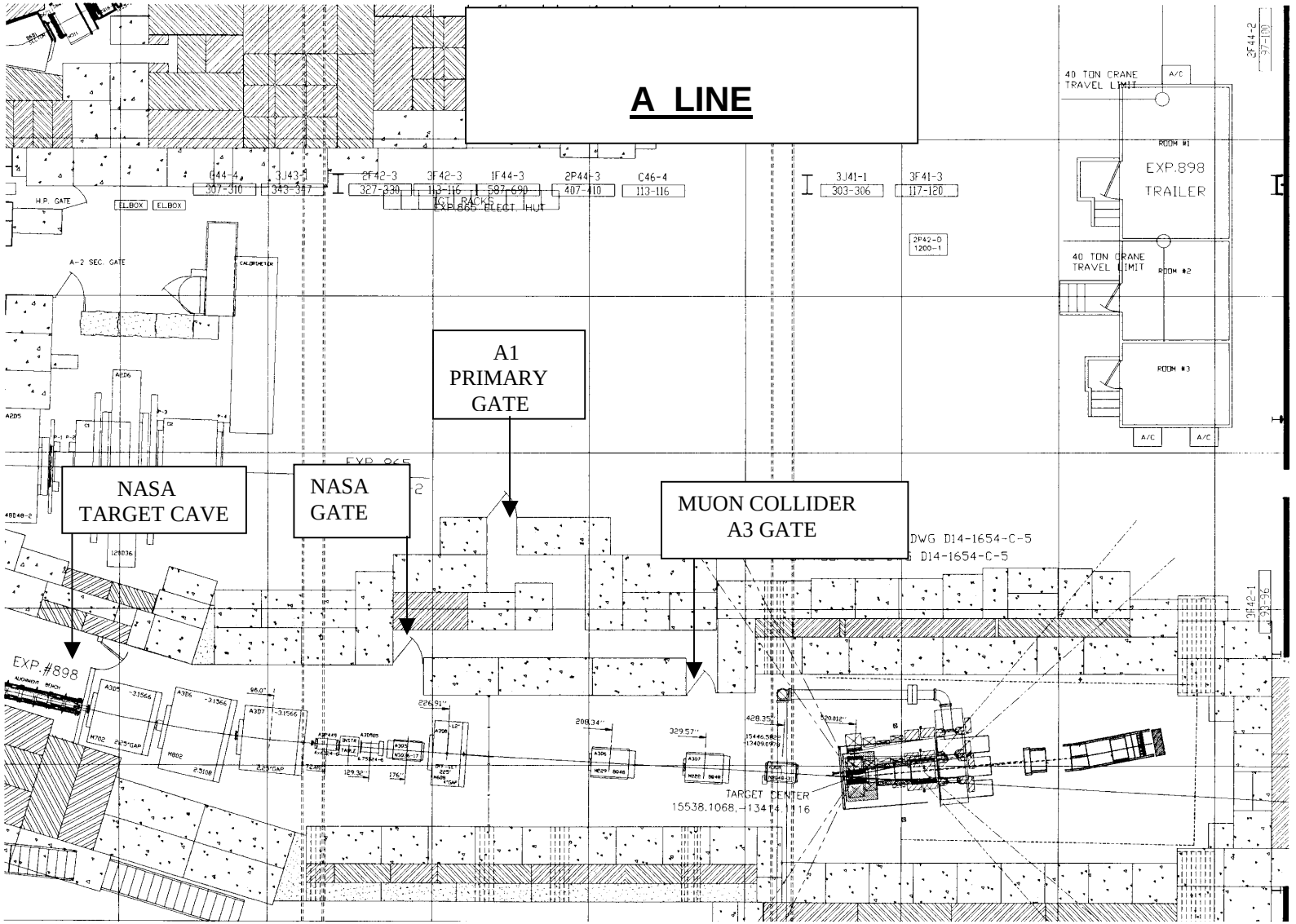
Fast Extracted Beam Areas, g-2 Experimental Area

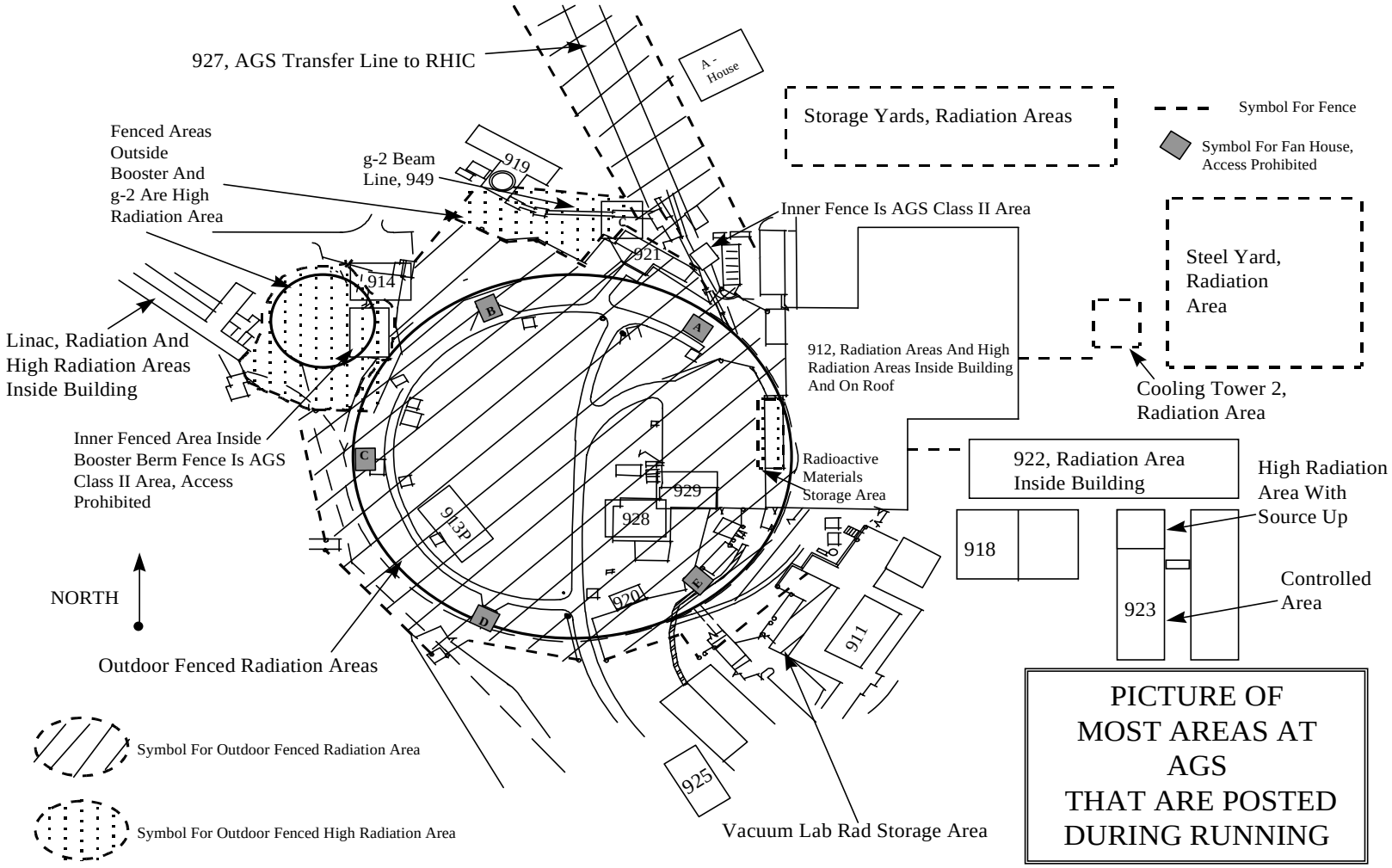
BUILDING 927 ACCELERATOR TO COLLIDER TRANSFER LINE





SLOW EXTRACTED BEAM AREA IN BUILDING 912


A LINE
A1
PRIMARY
GATE
NASA
TARGET CAVE
NASA
GATE
MUON COLLIDER
A3 GATE
EXP.#898
EXP.898
TRAILER
40 TON CRANE
TRAVEL LIMIT
ROOM #1
ROOM #2
ROOM #3
H.P. GATE
A-2 SEC. GATE
EXPLOSIVES ELECT. HUT
TARGET CENTER
15538.1068,-13414.1116



E. Lessard 9/96

EXPERIMENTAL AREA HAZARDS

Under no-beam conditions, primary and secondary experimental areas normally do not present a radiation hazard. However, neutron, beta and gamma sources are occasionally stored in these areas. Some detectors contain uranium or other radioactive materials. A few shield blocks on the experimental floor are activated; that is, they have been made radioactive by the beam, and these blocks are marked with radiation symbols and the word "RADIOACTIVE."

There are mechanical hazards associated with pressure vessels and vacuum vessels. Large, thin windows (several ft^2 in size) on large vessels under vacuum (larger than 350 ft^3) have enough potential energy to exert a tremendous pulling force should the window break. The pull would be the equivalent to falling off a three-story building. IF there is no protective cover in place, or IF there is not sufficient distance between you and the window (10 feet), THEN DO NOT work in or around a large window when it is under vacuum. Additionally, the noise from an inadvertent window implosion may cause permanent hearing loss. You should obey any postings related to the use of hearing protection. You must follow all procedures that require you to put a protective shield in-place before entering areas that have vacuum window hazards.

There are many large material-handling devices on the floor, and many structures are supporting heavy loads. Additionally, there are mechanical hazards associated with compressed gas systems that could result from improper line pressures and malfunctioning regulators. Be aware of these hazards. Report any suspicious-looking structures or compressed-gas systems to your Liaison Engineer or Liaison Physicist.

HANDLING LEAD (Pb)

You will encounter Pb in the primary areas. Please be aware that handling Pb may be hazardous and you are required to use protective equipment such as gloves. Pb may be found in brick, sheet, or cast forms, or as wool which is used in Pb blankets. In most applications, the bare metal should be covered or painted if practicable. You need to wear safety shoes in addition to gloves when handling Pb bricks or sheets of Pb. You are not allowed to shape, drill, or otherwise work with Pb in any way that causes it to become dispersible. If you need assistance with shaping or cutting Pb, then contact the C-A ESH&Q Division Head (x5272, pager 4820), or ES&H Coordinator (x7200, pager 5605 or x 7036, pager 6152).

ELECTRICAL SAFETY TRAINING

If you work on electrical circuits that are powered through circuit breakers, disconnect switches and / or fuses, then you must LOTO the circuits. OSHA, BNL and AGS require that all workers performing these tasks be trained.

The AGS has three courses covering electrical safety that you may be required to take and pass:

- Electrical Safety,
- Lockout / Tagout and
- Working Hot.

Electrical safety training is required if you plan to work with:

- AC voltages greater than 50 Vac,
- DC voltages greater than or equal to 50 Vdc,
- systems with greater than 10 ma of available current, or
- systems that are capable of releasing 10 joules or more of energy instantaneously.

Contact with energized electrical circuits may not kill but can knock you off a ladder or cause you to bump your head. Additionally, the short circuit capacity of the 120/208 and 480 volt systems is much above that encountered in most industrial and/or research facilities. All connection and disconnection to these systems must be made by BNL personnel only. You must use caution on any equipment connected to these systems since a short circuit can produce a large arc with a resultant molten metal spray. You should be aware of the requirements for fusing and other protective circuitry for your equipment.

Contact the C-A Training Manager (x7343) to arrange for additional electrical safety training. **You are forbidden to work on energized electrical systems (working 'hot') unless you receive authorization from the C-A ESH&Q Division Head (x5272, pager 4820), ES&H Coordinator (x7200, pager 5605 or x 7036, pager 6152).** Label your equipment. Be familiar with your equipment and do not use anything that seems unsafe. **IF you do not know from whence it came, THEN DO NOT use it.**

Recently, Users found an extension cord near their experiment, and decided to use it. This unknown cord had the hot and neutral reversed and the ground had been cut or corroded away. Aside from damaging a computer and a measuring device that cost several thousand dollars, this hazardous cord was potentially lethal since the safety ground was energized. The bottom line is DO NOT use homemade extension cords; USE the molded type.

You should know the location of the emergency-off controls for power to your equipment. There should be no exposed electrical terminals in your equipment that present a hazard to yourself or other Users.

All cables should be labeled and properly terminated or removed when disconnected. This will prevent potential shock hazard to anyone working near unused cables.

Question: while working on your equipment, you encounter exposed conductors and you are not certain they are live, what would you do?

Answer: warn your collaborators and contact your Liaison Physicist.

CRYOGENIC AND FLAMMABLE GAS/LIQUID SAFETY

All cryogenic devices must be reviewed by the Laboratory's Cryogenic Safety Committee. All cryogenic targets must be fabricated and operated by the C-A Cryogenic Group in the Facilities and Experimental Support (F&ES) Division. Cryogenic devices present the hazards of extreme cold, asphyxiation, or explosion.
Many experiments involve the use of flammable gases, and flammable liquids. The gas distribution and gas mixing systems must meet the requirements of BNL

Environmental, Safety and Health (ES&H) Standards. These standards are issued to Liaison Physicists, Liaison Engineers and Experiment Spokespersons.

COMBUSTIBLE MATERIALS

Users occasionally collect wood, plastic, paper or other combustible matter in significant quantities near experiments. We must strive to remove these materials where possible, and we should strive to meet the life-safety code by not blocking exits or aisle ways with these materials. Metal sheds to the north of Building 912 are assigned to Users for the purpose of storing experimental equipment, cables, packing materials and other combustible items.

FIRE SAFETY

The fire safety program at BNL emphasizes prevention through the design of buildings and automatic protection. If you suspect a fire telephone 2222 or 911, (cell phone 631-344-2222) Fire Rescue Group. Once a fire has been reported warn everyone in the area and evacuate as required. If you think you can combat the fire without putting yourself in danger, a fire extinguisher may be effective. **Never let the fire get between you and your escape route**. Use a fire extinguisher only if you are trained and it can be done safely. Only use a fire extinguisher if you're confident in your ability to put out the fire safely. Determine what is burning and select the appropriate fire extinguisher. Fire extinguishers are classified according to their ability to handle specific types and size fires. If you have any doubts, let firefighters handle the situation.

MAGNETIC SAFETY

Use extreme caution with iron and steel objects when working around magnets, especially those with large gaps. Follow all magnetic safety plans that are specific to your experiment. **Please note that lockout of a magnet for magnetic safety is NOT to be substituted for a lockout for electrical safety.** Be sure you do not inadvertently energize a magnet before the area is clear. Remember the field may be effective at a surprisingly large distance. Aside from possibly pulling ferrous objects from your grasp, your credit cards may be damaged if you get too close.

The American Conference on Governmental Industrial Hygienists (ACGIH) recommend exposure limits for static magnetic fields. Exposure of the whole body should not be allowed in fields greater than 600 gauss on a daily basis (8-hour time-weighted average), and extremities like your arms and legs should be exposed to less than 6000 gauss (8-hour time-weighted average). Cardiac pacemaker wearers should not be exposed to fields greater than 5 gauss. DOE has adopted ACGIH recommendations as its own standards and has indicated this through DOE Orders. Thus, you should limit your own personal exposure according to these rules.

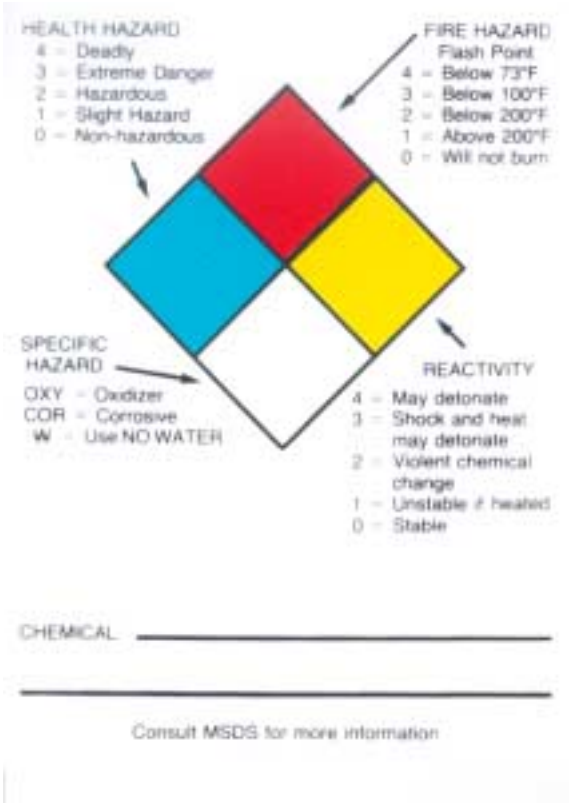
CHEMICAL SAFETY

For your safety, purchased chemicals are inventoried by the Laboratory prior to delivery for end use. If you bring un-inventoried chemicals on site contact the ES&H Coordinator (x 7036, pager 6152 or x7200, pager 5605) to have these chemicals inventoried and bar coded prior to use.

INFORMATION ON HAZARDS, YOUR RIGHT TO KNOW .

You have the right to know about potential health and safety hazards in your workplace, whenever the potential for exposure to hazardous materials exists. You will be provided with specific safety and health information by the ES&H Coordinator. Contact the ES&H Coordinator at (x7200, page 5605 or x7036 page 6152). The Coordinator can provide you with information on the Laboratory's policy on hazardous information, how to obtain Material Safety Data Sheets (MSDS) and interpret them. Some of the information that can be found on an MSDS is the name of the chemical, manufacturer, hazardous ingredients, physical characteristics, fire and explosion hazard data, reactivity data, health hazard data, precautions for safe handling and safety control measures.

National Fire Protection Association (NFPA) diamonds appear on various materials containing structures and containers to the degree of hazard for these materials.

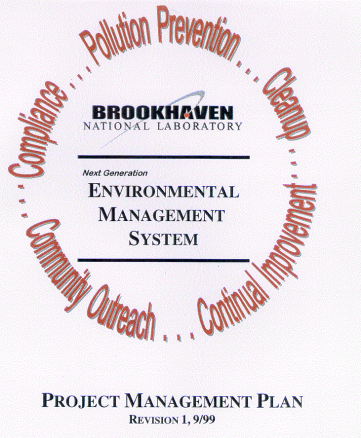


The ES&H Coordinator can also provide information on how to select and use protective equipment, and explain the labeling system used on chemical containers.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Department safety policy states that each workplace should be created and maintained in a manner that minimizes safety and health problems. For some jobs, this is not always practical. In some cases protective clothing and equipment is required for safety. Plan your work in advance. Consider whether PPE may be needed. You must contact the C-A ES&H Coordinator (x7200, pager 5605 or x 7036, pager 6152) whenever PPE is to be used for approvals and reviews.

ENVIRONMENTAL MANAGEMENT SYSTEM



The goals of the Environmental Management System are to ensure that you know and comply with environmental regulations associated with your work. That you know the potential environmental aspects and impacts associated with your work and how to prevent, respond and mitigate impacts. Strive to practice the techniques of pollution prevention and waste minimization. BNL employs the EMS program defined by the International Standard, ISO 14001. There are five points to BNL's policy and commitment.

1) Pollution Prevention
Strive to prevent pollution, minimize wastes and conserve resources.
2) Compliance
Comply with all applicable environmental requirements.
3) Clean Up
Aggressively correct and clean up existing environmental problems.
4) Continual Improvement
Protect our ecosystem and community by continually improving the way we manage our programs.
5) Community Outreach
Openly communicate our progress and performance to our community and stakeholders.

The work that you perform may have potential environmental impacts associated with it. If so, you will be required to observe specific controls designed to prevent such impacts. Your Liaison Physicist can explain those controls, or you may contact the C-A Environmental Compliance Representative (x7045) for details.

WASTE DISPOSAL

CAUTION:

Improper disposal of radioactive or hazardous waste may result in fines, criminal prosecution, and facility shutdown. Contact the C-A Environmental Coordinator (x7520) well in advance to establishing any airborne, liquid or solid radioactive- or hazardous-waste-stream. The C-A Environmental Coordinator is familiar with rules, permits, authorizations and analysis requirements necessary for proper disposal

Removing waste from the Laboratory is complex and costly. Your cooperation is necessary in order to control waste according to Federal, State, and Suffolk County regulations. Additionally, the regulations of States where waste from C-A is ultimately disposed of must also be followed.

- Do not place clean materials in radioactive waste bins.
- Do not place radioactive materials in the green 3-yard bins used for clean waste.
- Substitute reusable materials where possible.
- Use minimum quantities of materials.
- Segregate wastes.
- Do not leave unnecessary items in primary areas.

Each person is responsible to ensure that they handle, accumulate or dispose of waste by using adequate controls and documentation. Your Liaison Physicist can explain those controls, or you may contact the C-A Environmental Compliance Representative (x7045) or Environmental Coordinator (x7520) for details.

SPILLS

The C-A is required to report spills. The C-A must always report quickly to outside agencies on events that deal with impacting the environment. Even minor events such as spilling any amount of oil in an outdoor area may require reporting. The rules are such that we must *consider* reporting spills of any type or size. IF you spill any hazardous liquid or oil outdoors on the bare soil or if you spill 5 gallons or more of hazardous liquid or oil on any impervious surface, THEN call x2222 or 911, contact the C-A Main Control Room (x4662), the C-A ES&H Coordinator (x7200 or x4617) or the C-A Environmental Coordinator (x7520) as soon as you can. DO NOT leave a message on an answering machine. Report the spill giving your name plus information on the location of the spill and the type of material involved if you know it.

Spills that do not have to be reported are spills that occur as a result of routine operations as long as the following conditions are met:

- The spill occurs indoors.
- The spill occurs on an impermeable surface.
- The material spilled is not a highly toxic or highly volatile material (such as methylene chloride).
- The material spilled is does not contain (or suspected to contain) polychlorinated biphenyls (PCBs).
- The person reporting the spill has appropriate training and materials to clean up the spill.
- The spill is cleaned up immediately.

The ES&H coordinator is to be contacted in the event of a spill to evaluate and coordinate the clean up efforts.

HARDHAT POLICY

You are required at the C-A complex to wear a hardhat if you are in an area when an overhead crane is in operation. Do not continue to stand under objects being handled by the cranes. You are required to wear a hardhat if people are working above you. *Construction areas* require a hardhat at all times.

USING MACHINE TOOLS TO SUPPORT RESEARCH

If you need to use tools that are available at several C-A machine shops, then you must contact the Building Manager for that shop prior to use. Building Managers are identified on placards near building entryways. Machine tools are considered drill presses, lathes, etc. In addition to employing the standard machine guards while you do the work, you must be trained in machine tool safety. This half-hour safety video may be viewed by contacting the C-A Training Manager, at x7343.

PRICE ANDERSON AMENDMENT ACT (PAAA)

The Price Anderson Amendment Act a Congressional Act is designed to protect the health and safety of workers and the general public. The DOE radiological safety requirements found in the Code of Federal Regulations (10 CFR 835), along with the PAAA requirements apply to all employees, guests, and contractors. Each person is responsible to adhere to these regulations and requirements.

It is important to make you aware of the absolute requirement to follow all radiation safety rules at C-A facilities. Federal law (PAAA) provides for criminal and monetary penalties if you do not follow the rules fully. Persons have been the subject of criminal investigations when found to willfully remove a radiation barrier. Thus, we request that you pay particular attention to the radiation safety rules that follow.

Are Users at AGS accepting additional legal liabilities under the Price-Anderson Amendment Act when signing documents related to compliance with radiation safety rules? The short answer is that the User incurs no personal liability under the provisions of the Act unless he/she intentionally acts to violate the radiation safety rules.

The Price-Anderson Act sets up a regulatory program for enforcement of radiation safety rules, including radiation protection standards (10 CFR 835). Failure to comply with those rules, or to identify and report non-compliance to DOE, subjects the Laboratory, not an employee, to an enforcement action. This could include a

legal Notice of Violation and a civil penalty up to $100,000 per violation.

When signing documents related to radiation safety, such as the training documents associated with this course, a User is essentially confirming that he/she will do his/her assigned experiment according to the rules. The signature does not mean that the User is guaranteeing that the experiment will be carried out perfectly or that there is no potential for a violation. It does mean that the User is performing his/her duties with a good faith effort to comply with the radiation safety rules. A "good faith effort to comply with the rules" means that the User follows them to the best of their ability and has familiarized him/her-self with the requirements of regulations that fall within his/her area of responsibility. Having done so, he/she should be in a position to approve or sign-off on procedures or training to carry out work involving radiation safety.

WARNING

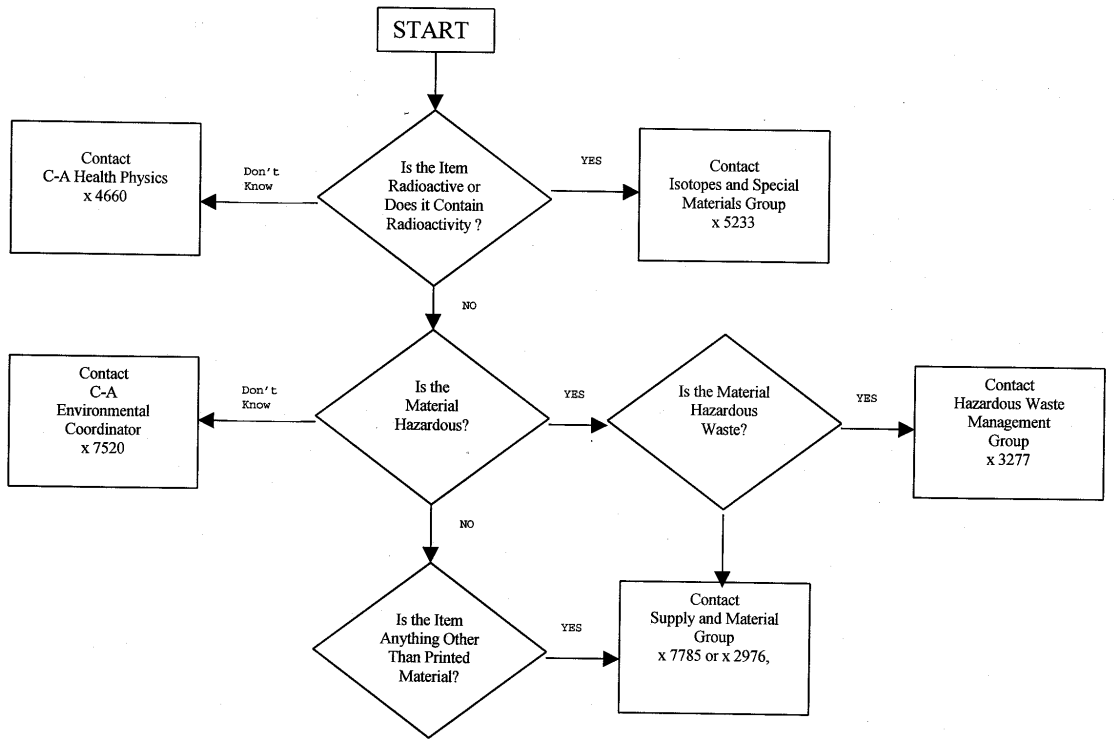
It should be understood that any User who intentionally violates any regulation, regardless of whether the User signs any document related to compliance, is subject to criminal prosecution or other disciplinary action.

DELIVERIES TO C-A FACILITIES

In recent years, the delivery of materials to C-A has become complicated due to our attempt to comply with Price Anderson Act Amendments. Under Price Anderson, we are required by Federal law to obey all radiation safety rules or face stiff penalties if we do not. All persons, including delivery people, who enter Radiation or Controlled Areas either must be wear a TLD, be properly trained, or be escorted by a trained Radiation Worker. To ensure that DELIVERY PEOPLE DO NOT ENTER POSTED AREAS, the department requires that all deliveries to the C-A complex be made to **Building T 89**.

Arrangements can be made with the Main Control Room, ext. 4662, for off-hour deliveries. When the delivery is made to the MCR, personnel there will then contact the addressee. Under no circumstances are deliveries to be made to other buildings in the C-A complex without approval of the C-A ESH&Q Division Head (x5272, pager 4820) or ESH Coordinators (x7036, pager 6152 or x7200, pager 5605). WHEN PLACING AN ORDER, INFORM VENDORS TO PUT YOUR NAME ON THE PACKAGE (packages arriving without a NAME will be sent back) AND STATE THAT DELIVERIES ARE TO BE MADE TO **BUILDING T89.**

IF YOU ARE SHIPPING FROM C-A TO OFF-SITE, THEN ASK YOURSELF THESE QUESTIONS AND FOLLOW INSTRUCTION PRIOR TO SHIPPING



BNL MANAGEMENT SYSTEMS

Brookhaven National Laboratory has put into practice a series of management systems to help ensure that work is done in a safe and environmentally conscientious manner. These management systems detail the processes and procedures that are associated with different types of work and are available to everyone via the BNL Standard Based Management Systems (SBMS) internet web site. SBMS is BNL's method for implementing the Integrated Safety Management System (ISM). ISM combines Environmental, Safety and Health requirements into the process for planning and conducting work here at the laboratory. Physical work activities are governed by the Work Planning Process.

WORK PLANNING AND SCREENING AT C-A

All jobs at C-A must be screened for ES&H hazards. The hazard levels for screening work are as follows:

Low-Hazard Work is work requiring the attention of the average performer to prevent minor injury. Failure to correctly perform low-hazard work would not damage equipment or structures or release potentially hazardous materials to the environment, except as a result of gross negligence.

Moderate-Hazard Work: Work requiring coordinated actions to prevent any injury to personnel, minor damage to equipment or structures, or release of hazardous materials to the on-site environment.

High-Hazard Work: Work requiring coordinated actions to prevent serious injury to personnel, significant damage to equipment or structures, or releases of reportable quantities of potentially hazardous materials to the off-sight environment.

Many Tasks necessary to maintain, repair, and debug experiments will be carried out by Users. Much of this work is deemed low hazard or “Skill of the Craft”. A list of “Skill of the Craft” jobs is maintained at each experiment. The Users is required to review this document.

Jobs involving Users are normally screened during formal reviews and walk-throughs by the C-A Experimental Safety Review Committee. However, last-minute changes to experiments that require Users to perform jobs that fall in the moderate to high hazard category must be brought to the attention of the Liaison Physicist. **It is an Experiment Spokesperson's responsibility to ensure that all work by the collaboration is properly planned and reviewed for ES&H issues.**

CONDUCT OF OPERATIONS

OPERATIONS

COORDINATOR

X4662

The main control room (MCR) is the focal point of beam control and status. While the accelerator is operational, the MCR is staffed. Call x4662 for immediate assistance on any problem. The execution of the overall HEP and HIP programs from the MCR is the primary function of the Operations Coordinator (OC).

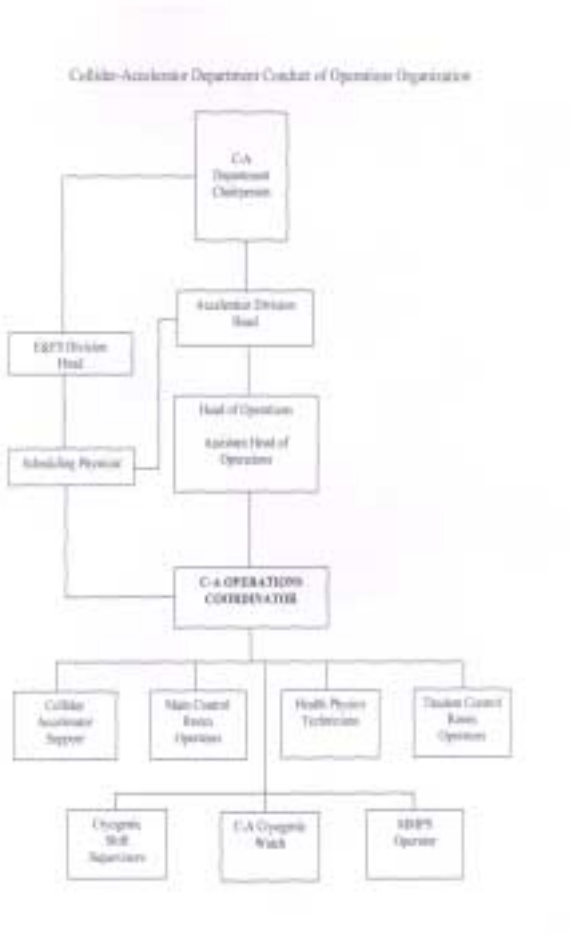
The OC is authorized to enlist the support necessary to maintain or restore the accelerator or experimental support system to operational status. The OC is responsible for providing beam that is satisfactory to the experimenter. The OC keeps current on the status of all experimental groups in the experimental areas, and in case of operational conflict or incompatibility, attempts to effect a resolution. For assistance in carrying out his/her duties, the OC consults with the scheduling physicist, technical specialists, and departmental managers.

The C-A Department urges you to communicate with the OC via the MCR whenever you need assistance on any matter. This is particularly important on the shifts that occur during non-standard work hours. The OC may not be able to answer questions directly or provide the assistance directly, but he will make use of the operational groups who report to the MCR.

After the experiment is running, all operating problems are directly handled by the Facilities and Experimental Support Group (F&ES) Watch.

You may contact the Watch by calling the Target Desk at x2042 or by calling the OC x4662. Problems involving collimators, power supplies for beam-line magnets, Hall probes, beam separators, cryogenic targets, vacuum systems, vacuum window shutters, air conditioning, electrical equipment, and requests for emergency rigging should be reported to the F&ES Watch.

You only need to remember one telephone number, x4662, in order to get assistance on any matter. That is, IF you have any problems or questions, THEN contact the MCR (x4662). The OC will assist you or direct you to the appropriate safety or operations professional.



REMEMBER:

During AGS operations, contact the Operations Coordinator (x4662) regarding any problem; he can make all the necessary notifications or arrange for assistance.

RADIATION HAZARDS

- PRIMARY BEAM: in-beam dose rates up to 10^{14} mrem/h from hadrons.
- SECONDARY BEAM: in-beam dose rates up to 10^{11} mrem/h from hadrons, and leptons.
- FAULTS: radiation penetrating through shielding from unplanned beam losses may lead to doses of several tens of

mrem from neutron and gamma radiation near shielding or fences. Faults may last up to a period of about nine seconds before machines are interlocked off.

- NORMAL OPERATIONS:
  - About 1 to 2 mrem/h or less in continuously occupied areas from neutron, and gamma radiation that penetrates the shielding.
  - Cooling water lines are 100's mrem/h during running periods and for several minutes post shutdown (gamma).
  - Air activation: 100's mrem/h from airborne radioactivity in target caves for several minutes post shutdown (beta, gamma).
  - Short-lived contamination (30 minutes) from air activation in primary beam lines. Up to 5000 dpm/ 100 cm^2 of floor surface for several hours post shutdown (beta, gamma).
- RESIDUAL RADIATION:
  - Primary beam components are up to 10,000 mrem/h (gamma).
  - Targets are up to 50,000 mrem/h (gamma). V target may be 100,000 mrem/h or more immediately after shutdown.
  - Primary shield blocks inside target caves are 100's mrem/h (gamma).
  - Long-lived contamination in C3 beam line (beta, gamma).
  - Long-lived radioactivity created in soil near targets, beam stops, and beam scrapers (100's of mCi of tritium and ^{22}Na).

The principal radiation hazard associated with the AGS primary areas derives from the high-level residual-radiation. If possible, the primary areas that are selected for experiments are chosen to be areas where little activation has occurred.

Direct exposure to the beam is not possible if areas are entered in the correct way. However, exposure to radiation from unplanned beam losses in adjacent primary areas is possible. This may result from brief excursions lasting a few seconds such as during a beam crash due to loss of a steering magnet power supply.

RESIDUAL LEVELS IN PRIMARY EXPERIMENTAL AREAS WHEN BEAM IS OFF

AREA	LOCATION	RESIDUAL LEVEL, mrem/h
A Primary Line	Radiobiology Station	0.5
Muon Storage Ring	Near Inflector	0.5
	Shield Block Wall	1
U Line	Block House	50
	Beam Stop	90

The approximate dose rates shown in the previous table are based on radiation surveys taken shortly after operations.

RADIOLOGICAL AREA DEFINITIONS

Controlled Area -- any area where access is controlled due to the presence of radiation above natural background levels or due to the presence of man-made radioactive materials. As a minimum, these areas are posted “Controlled Area.”

Radiation Area -- any accessible area where an individual may receive a whole-body

dose greater than 5 mrem in one hour at 30 cm (1 ft). As a minimum, these areas are posted "Radiation Area, TLD Badge Required."

High Radiation Area -- any accessible area where an individual may receive a whole-body dose greater than 100 mrem in one hour at 30 cm (1 ft). As a minimum, these areas are posted "Danger, High Radiation Area, TLD Badge and SRD Required."

Very High Radiation Area -- any accessible area where an individual may receive a whole-body absorbed-dose greater than 500 rad in one hour at 1 m (3 ft). These areas are not posted at AGS since they are not accessible.

RADIATION LEVELS, AREA NAMES, AND TRAINING REQUIRED

Allowable Radiation Level	Area Name	Training Course(s) Required
< 5 mrem in one hour < 100 mrem in one year	Controlled Area	General Employee Radiological Training (GERT) *C-A Facility Specific Training
> 5 mrem in one hour < 100 mrem in one hour	Radiation Area	Rad Worker I Training *C-A Facility Specific Training
> 100 mrem in one hour	High Radiation Area	AGS Facility Specific Training Such as This Course

*Contact C-A Training Manager (x 7343) for specific training requirements

The AGS accelerator complex has many Radiation Areas, and dose rates may be greater than 5 mrem in an hour. These areas are marked-off by ropes, fences or building walls. All entrances, every forty feet of fence or rope, and many Hot Spots are posted with Radiation Area signs. In order to work in or pass through Radiation Areas without an escort, you must complete Radiation Worker 1 training.

In primary areas, the radiation level may be greater than 100 mrem per hour and up to 50,000 mrem per hour. In order to work in these areas, you must complete Radiation Worker 1 training plus facility specific training such as this course.

TRAINING SCHEDULE			
Course	Place	Time	Challenge Exam Option
Rad Worker I Training (RW I)	Bldg. 129 Training Room or Berkner Hall Consult w/ Training Manager (x7343)	Every Tuesday 9:00 a.m. to 3:00 p.m.	Contact Training Manager (x7343)
AGS Special User's Training For Access To Primary Areas	Contact Training Manager (x7343)	Scheduled as Needed	Contact Training Manager (x7343)

ACCESS CONTROL FOR PRIMARY AREAS

At the AGS, the Access Control system is the major design feature used for your protection and it has two states, Access Prohibited and Access Allowed. In the Access Prohibited state the machine is either operational or it is "cocked and ready to fire." Radiation hazards may be at their extremes in this state and are lethal. Thus, no entry is allowed.

To prevent entry, the electric key-strike on each access gate is disabled from the Main Control Room, and gates will no longer work with a single access key. If a gate is forced open, then two sensors will detect the door's open position and cause at least two critical devices, such as beam stops, to intercept the beam before one can penetrate the area to any significant degree.

ACCESS PROHIBITED TO VERY HIGH RADIATION AREAS

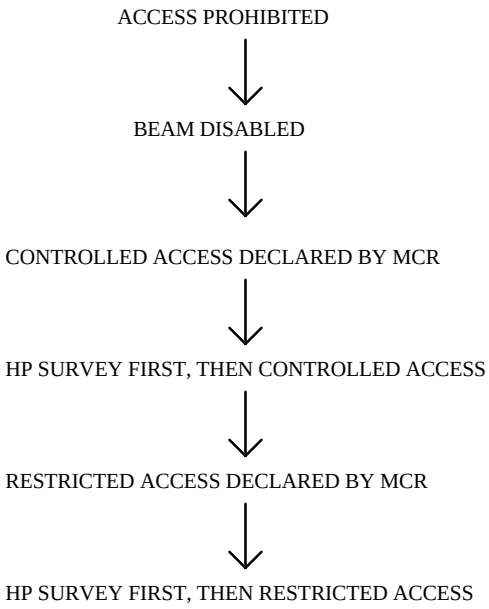
The following is true whenever the primary areas are in the Access Prohibited state:

- All electric strikes on access-gate doors are disabled; thus, preventing entry.
- All access gates have a minimum of two sensors to detect an open door.
- Two critical devices will stop the beam if interlock occurs.

In the Access Allowed mode, two major sub-states have been defined, Restricted Access and Controlled Access, and each has a number of significant features and

requirements that are described in detail on the following pages.

A flow diagram shows the steps the AGS takes in going from the highest level of restriction to the lowest:



ACCESS TO CONTAMINATION AND HIGH RADIATION AREAS

To provide Radiation Workers with a method to review tasks in High Radiation Areas, Contamination Areas (areas where the removable surface contamination levels exceed prescribed limits), and Radiological Buffer Areas (intermediate area established to prevent the spread of contamination), and that the personnel are cognizant of the prerequisites to enter such areas, a sign in form is used prior to entry. All Radiation Workers intending to enter such areas must complete the Contamination Area and High Radiation Area Sign-In Log. This list is designed to act as a checklist for entry requirements . Posting in these areas are to be read carefully before entering. Note that Contamination Areas and Radiological Buffer Areas require additional laboratory training for unescorted access.

Contamination and High Radiation Area Sign-In Log Located at South Gate

ACCESS ALLOWED TO HIGH RADIATION AREAS

One of either of the following sub-states exist whenever the primary area is in the Access Allowed state:

- Controlled Access
- Restricted Access

Question: true or false? - the primary means of ensuring that people are not in primary areas before turning on the beam is by conducting a manual sweep of the areas.

Answer: true. All primary areas are swept exclusively by Main Control Room Operators prior to going from the Restricted Access state to the Controlled Access state.

CONTROLLED ACCESS

- The conditions, requirements, hazards and restrictions that apply to Restricted Access apply to Controlled Access.
- While all systems have a barrier and most have been turned-off, only 5 to 7 electrical systems have been locked out and tagged.
- A gate watch with C-A operators, Facilities & Experimental Support or Health Physics Technicians will be established at a single gate.
- Access is accomplished by entering and exiting through this one and only gate.
- Entry requires simultaneous key release at the gate and at the MCR.

Under Controlled Access, only a few electrical systems associated with the accelerators are locked out and tagged. Most electrical systems in experimental areas may simply be turned off. The 256-Key or 0-Key alone do not work. Access is achieved by entering or exiting through one gate, and by a sign-in / sign-out system.

Entry through the gate requires simultaneous key release by personnel at the gate (usually C-A personnel but may be specially trained Users) plus an Operator stationed in the Main Control Room.
In the FEB areas, exiting the primary area also requires simultaneous key release by AGS personnel at the gate plus an Operator stationed in the Main Control Room. In the near future in FEB areas, a video camera may take the place of the gate watch during Controlled Access. If there were no Gate Watch, a User would be able to determine if the primary area is on Controlled Access by observing an amber light at the entry gate box.

A public-address system announcement is made when going from Restricted Access to Controlled Access in the SEB areas. In the FEB areas where Users perform experiments, a PA announcement is also used to alert personnel of the change in status. If you are present in the area when going from Restricted Access to Controlled Access, you will be asked to leave. The area is then swept by Main Control Room Operators and you may re-enter under Controlled Access conditions. Most high-power electrical systems will be on or under test when you re-enter. Additional Public Address System announcements will be made regarding the status of equipment as it changes during Controlled Access.

In the experimental areas that are also primary areas, going from the Access Prohibited state to the Controlled Access state does not require the C-A Radiological Control Technicians (RCT) to enter and survey the primary area for recent activation.

Generally, at least one 15-minute delay is required before entering primary areas after a beam-off condition. This is done to allow airborne radioactivity to decay. In primary areas where experimenters are located, a 15-minute delay is generally not required. These experimental areas have been set up to reduce the likelihood of short-lived air activation.

Question: true or false? - Controlled Access means you must log in with a Gate Watch and enter and exit through the same gate.

Answer: true. The Gate Watch must know where you are so Operators do not have to re-sweep the area.

RESTRICTED ACCESS

NOTE:

Entry is not controlled by a gate watch during Restricted Access. All who are issued a 256-Key or 0-Key may enter and exit at will.

Many electrical systems are locked and tagged during Restricted Access. This pertains only to beamline equipment not controlled by Users.

During Restricted Access to primary areas associated with experiments:

- There is no beam.
- Radiation Worker 1 Training and Special AGS User's Training are required for entry.
- A 256-Key or 0-Key, and TLD badge are required.
- A Self-reading digital dosimeter
- You should be aware of your dose for the year-to-date.
- Dispersible activated debris such as leaking pump oil or broken vermiculite bags may be present.
- High-voltage electrical hazards such as Wood's metal wiring, vacuum pumps, and security-system wiring will exist.
- Escorting of untrained Users is not allowed.

In order to enter the primary areas during Restricted Access you require a 256-Key or a 0-key. All keys are issued from the C-A Training Office (A-128). Loaner keys may be obtained from either the Training Office or the C-A Main Control Room. In most cases, Users will not be issued a key on a permanent basis.

POWER FAILURE DURING ACCESS PROHIBITED MODE

From time to time, the battery back-up system for the access-control system fails during a power failure. If the backup system fails, then the access-controls system in the SEB areas (A Line for example) immediately inserts beam stops and drops to the Restricted Access state. It will not remain in Access Prohibited or drop to Controlled Access since these states in SEB areas require power. If the SEB areas have dropped to Restricted Access following a power failure, **then DO NOT attempt to enter primary areas with a 256- or 0-key immediately following a power failure; CONTACT the MCR first.**

ACCESS CONTROL FOR SECONDARY AREAS

The Controlled and Restricted Access features of the access-control system do not apply to secondary areas. Secondary areas are considered Radiation Areas when the beam is off.

Full enclosures around the secondary area; that is, enclosures with roofs in addition to side fences, are used when “in-beam” dose rates are greater than 2,500 rem in an hour. The Radiation Safety Committee has determined that the lateral dose rate many feet away from such a beam, even if it is enclosed in a beam pipe, could be unacceptable.

Lateral dose rates at 3 feet from a “crashed” beam are typically $2x10^4$ times less than the

in-beam dose rate pictured here. Therefore, a 2500 rem/h “in-beam” dose rate is about 100 mrem/h at 3 feet to the side of a crashed beam. Thus, fencing at 20 to 30 feet along the sides of secondary beam lines is adequate to reduce dose rates to acceptable levels. These low-level dose rates at secondary area fences may either exist in a fault or routinely at some lateral distance from a secondary area beam stop.

Down-stream dose rates are increased over lateral dose rates due to the presence of a very penetrating muon beam. The muon beam is eliminated by increasing the length of the beam stop, and rendering the secondary beam incapable of being swept-off the beam stop by a magnet.

The bottom line is that you must respect these physical features of access control. Do not move fencing or beam stops or barriers. Contact the MCR if you notice breaks in the fencing or shielding around secondary beams.

Significant construction activity occurs in experimental areas prior to re-setting the area for beam. Whenever a new area is initially reset for a new beam, significant Liaison-Physicist manipulation of the beam controls occurs.
It is important to emphasize that during beam tuning, the Liaison Physicist has the authority to reset secondary areas and to ask that Users follow established procedures for access to their equipment. These procedures may be new to the User who has previously been involved in the construction phase of the experiment only. Construction is a time when entrance gates and fences may have been removed or at the very least may not have been posted. Beam tuning is a critical transition period when beam may not be present for hours or days. Communication between the Liaison Physicist and the multitude of anxious Users may be brief. However, after a secondary area is fenced and reset, it is "cocked and ready to fire." During this period, it is important that you clearly understand and follow the instructions of the Liaison Physicist.

Question: can secondary beam-line fences be climbed over when beam is off?

Answer: no. All fences and barriers must be observed by Users regardless of the status of the beam. Always use the designated gate for entry into a secondary-beam area. Entry through the gate ensures that beam cannot be transported through the secondary area while you are inside.

GATES ARE LOCKED AND EXIST FOR RADIATION PROTECTION

- The 256-Key and the 0-Key are the main keys that allow personnel to access AGS primary areas unescorted. NEVER let another person use your key or tailgate.
- You are the person most responsible for your safety. Use common sense. Never assume you know all the hazards.
- When in doubt, consult an expert. Your Liaison Physicist or the Health Physics Office (x4660) can assist you in all your radiation problems and concerns.

The SOLE reason the C-A Department has fences, gates and other barriers at AGS is to prevent radiation accidents. You may be asked to show proof if you wish to enter certain AGS areas on Controlled Access. In most cases, the Gate Watch will have your training record available.

We know from national accident statistics that 10% of accidents result from unsafe conditions and that 90% result from unsafe acts. At C-A, our experience has also been that accidents and unusual occurrences are largely due to unsafe acts. We can and will continue to engineer hazards out of the AGS facilities. However, you are the person most responsible for your safety, and your attitude with regard to following the rules will always have the greatest impact on safety at C-A.

Question: what is the main purpose of the locked gates around the AGS?

Answer: to protect persons from radiation hazards.

Question: the 256-Key and 0-Key are the main keys to access High Radiation Areas associated with what facilities?

Answer: the AGS Department accelerators, the SEB and FEB primary beam-lines, and the AGS to RHIC transfer line.

Question: are there any circumstances under which you may lend your 256-Key or 0-Key to others or allow tailgating?

Answer: no. Only you may use your own key. You may not let any other person through the gate by holding it open unless you are a qualified C-A escort, or unless you are certain the other person is currently qualified to enter a primary area.

ARE ALL HIGH RADIATION AREAS POSTED?

A few primary areas are less than 100 mrem/h during shutdown. For example, A line (radiobiology station) and the g-2 muon-storage-ring. These areas may be posted as a Radiation Area or as a Controlled Area during shutdown. The bottom line is to read the posting before you enter the primary area in order to determine the appropriate radiological requirements.

With regard to posting, the C-A Department experience has been that too many signs allow information to go unnoticed. This was the case during an unusual occurrence at the LINAC. An area in the LINAC had been changed over to a Contamination Area, and an additional sign was added to the door next to the original High Radiation Area sign. Both radiation signs had similar markings, however, the newer sign had the words "Contamination Area." This sign was overlooked and contamination was spread outside the area.

On the other hand, too few signs may not provide enough of an alert. This was the claim several years ago when a User jumped a radiation barrier in the experimental areas. The User claimed the sign that indicated "ONLY USE THE GATE FOR ENTRY" was not apparent to him although it was posted at two different locations on the barrier. **The bottom line is to always enter through a gate since this is where signs are always posted.**

Radiation field data are normally posted using maps at the entrances to primary areas,

and an appropriate number of measurements are normally indicated.

The AGS accelerator complex contains a variety of radiological areas. The most common are Radiation Area and High Radiation Area. These areas are posted with a variety of signs that must be read before entering. These signs must be obeyed as they indicate training requirements, TLD requirements, and self-reading dosimeter requirements necessary to enter the area properly. These areas are also separated by a variety of barriers including fences, shield blocks and building walls. **DO NOT CLIMB OR DEFEAT THESE BARRIERS.** Always access these areas according to the rules.

The C-A Department imposes additional fence and lock requirements near most primary targets. Users are not allowed to go beyond these additional barriers.

Question: true or false - posting all hot spots at the AGS by health physics is <u>reasonably</u> achievable ?

Answer: true, but some spots are missed and signs may fall off.

GOLDEN RULES FOR RADIOLOGICAL AREAS AT AGS

- Do not climb over or defeat barriers
- Do not ignore signs, labels, alarms or warning tags
- If in doubt – Ask for help

Question: true or false? - the following may be ignored whenever you know the AGS is off: fences, barriers, signs, warning tags and alarms in radiological areas.

Answer: false. The AGS radiation protection program can only work if postings and barriers are obeyed at all times regardless of the status of the accelerators. Otherwise confusion occurs.

ACUTE RADIATION SYNDROME

When describing the biological effects of very high, acute doses of radiation, it is the practice to use measuring units of rad instead of rem. Animal studies used high doses of x-rays or gamma rays in a short period, and 1 rad equaled 1 rem for these studies. The following will result from a large dose over the whole-body in less than a day:

- 25 rad - temporary blood changes that can be detected by a physician using appropriate instruments
- 150 to 200 rad - observable symptoms such as diarrhea, vomiting, nausea, fatigue and hair loss
- 450 rad - lethal dose to 50% of exposed population within 30 days if medical attention is not given to fight infections

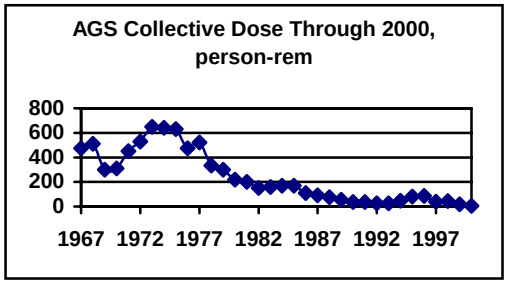
Small beams may interact with only a small part of the body if one is directly struck by the beam, leaving most of the body intact. Significant tissue damage may occur along the beam path as the beam penetrates the body. An acute, high-level, whole-body dose produces different biological effects in humans such as nausea, vomiting, hair loss and death. If you are directly struck by a

small beam, then the beam is likely to destroy a single organ or extremity such as an eye or a hand. In effect, high-intensity small beams behave like a bullet.

C-A EXPOSURE PHILOSOPHY

Radiation Exposure At C-A Must:

- Have A Net Benefit
- Be As Low As Reasonably Achievable (ALARA)
- Be Within Limits



Annually, about $100,000,000 will be expended to operate accelerators for experiments at the C-A complex. Once an experiment is configured, invaluable scientific information is obtained. Estimates of the economic worth of this information are difficult to enumerate, but it is assumed that this research has a net benefit. Obvious things that do not have a net benefit are:

- Radioactive jewelry
- Eating, drinking or smoking in radiation areas

Eating, drinking or smoking in a Radiation Area or a High Radiation Area at the AGS is not permitted. Doing so would increase the time spent in the area and correspondingly the dose, without increasing the net benefit. In addition, taking a shortcut through a Radiological Area in order to save time or to avoid inconvenience is not ordinarily an appropriate practice.

The collective dose, which is the sum of dose to all radiation workers at C-A, has declined in recent years. Based on experience, the annual collective dose for C-A staff approximately equals the product of 3 person-rem and the number of weeks of high-intensity proton operation.

The ALARA Committee consensus is that the majority of this collective dose comes from working on small, short-duration jobs. The Committee wishes to capture all SRD dose for all jobs in all radiological areas. The Committee would like to determine which dose goes with which job. We wish to point out that your cooperation in entering self-reading dosimeter data each day will help define jobs where further dose reduction can be achieved and avoid a PAAA violation.

ALARA STRATEGIES

Basic ALARA strategy on the part of the worker revolves around effective use of time, distance and shielding. Time tends to have a linear impact on dose reduction, distance a quadratic impact, and shielding an exponential impact. ALARA may also be incorporated into design and operations. The following are examples of ALARA at C-A:

- Track and reduce unnecessary beam loss
- Design and add temporary shielding
- Hold discussions in areas where the radiation level is the lowest
- Use remote handling equipment
- Use portable power tools
- Plan work and practice

- Install quick disconnect and alignment features on beam-line components
- Install radiation resistant devices
- Assemble parts out of the area
- Identify lower dose rate areas
- Use mirrors and video cameras

In the past, the most dose-reduction has come by way of Accelerator Improvement Projects (AIP). We have improved the reliability of the vacuum system, the beam injection system, and the beam extraction system. Additionally, the Experimental Facilities and Support Division has designed radiation hardened magnets that can operate properly after very high doses. This has resulted in fewer repairs, which in turn reduces the dose burden because we are working less frequently on broken, activated equipment. Additionally, new accelerator systems have been installed to achieve better control of beams, which results in less activation of equipment.

Information on collective dose associated with specific jobs is fed back through the C-A ALARA Committee and C-A management. The C-A Department learns which jobs or experimental areas are associated with the highest dose. This in turn may lead to a future AIP.

Question: true or false? - ALARA applies to anywhere it is reasonably achievable to reduce radiation dose.

Answer: true.

Question: how is ALARA achieved?

Answer: ALARA is applied most effectively at the design stage. It is accomplished through planning, job proficiency, shielding, and ALARA committee review and past experiences of staff and users.

ADMINISTRATIVE DOSE LIMITS

Administrative dose limits are an integral part of the dose reduction scheme employed by the C-A Department. These limits are LESS than the dose limits set by DOE and Federal Regulations.

C-A ADMINISTRATIVE LIMITS FOR VISITORS, UNTRAINED USERS AND MINORS

Untrained visitor or untrained User has a dose limit of 25 mrem per year. A limit of 100 mrem per year is allowed with written permission from the Radiological Control Division and the C-A ESHQ Associate Chair for Safety

Minor (<18 years) dose limit is 25 mrem per year. Minors are not allowed to work in radiological areas but are allowed to visit or tour radiological areas.

C-A ADMINISTRATIVE LIMITS		
Period of Interest	Maximum Individual Dose Limit, mrem	Individual Dose Limit With Line Authority Approvals, mrem
Calendar Year	1000	1000 to 1250 (C-A Chair Approval) 1250 to 2000 (Lab Director Approval)
Day	100	100 to 200 (Approval authority will be on the RWP)
Lifetime	N rem Where N Is Age of Person in Years	Laboratory Director Approval To Exceed N rem

The maximum daily dose to Radiation Worker 1 trained persons is 100 mrem. The C-A ESHQ Division Head may approve a dose between 100 and 200 mrem. The maximum calendar year dose is 1000 mrem. A formal approval must be obtained ***prior*** to going beyond 1000 mrem.

C-A Administrative Dose Limits apply to all personnel (staff, Users, visitors and contractors) who enter the C-A facility site. To exceed any C-A Administrative dose limit you must have written permission from the Department Chairperson or the Associate Chair for ESH&Q prior to exceeding any dose limit. If you are approaching any Administrative dose limit and foresee a need to exceed the limit, immediately notify your supervisor, and contact the FS representative.

After a female RWI-trained person voluntarily notifies the C-A management that she is pregnant, she is considered a declared-pregnant radiation-worker for the purpose of fetal and embryo radiation protection. The dose to the fetus during the gestation period is to be no greater than 350 mrem. We limit the rate to no greater than 40 mrem per month. **Given that there is marginal sensitivity to detect low-level neutron dose, Experiment Spokespersons shall not employ declared-pregnant radiation-workers around beam lines during high-intensity proton operations.**

The no-dose option is mandatory for declared pregnant workers who have already exceeded 500 mrem during the gestation period.

After a person voluntarily notifies the C-A management that she is pregnant, she must follow-up and notify management when she is no longer pregnant.

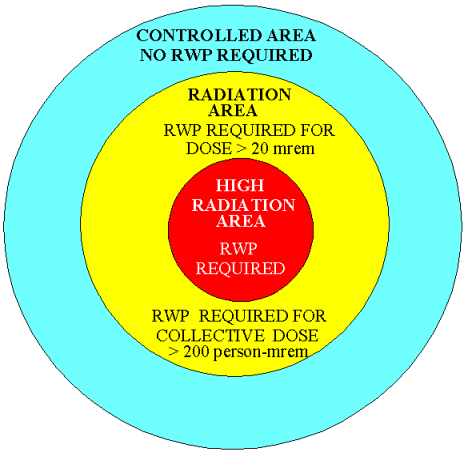
Untrained Users or visitors are limited to no more than 25 mrem per year. Written permission must be obtained from the C-A Associate Chair for ESH&Q and the C-A FS Representative to go beyond this; however, training is preferred. **During the high-intensity proton run, the AGS management DOES NOT ALLOW untrained persons into the experimental areas since exceeding the 25-mrem limit is possible in one day.** Escort may be allowed when not running high intensity protons.

The annual dose limit to minors and students under age 18 years is 25 mrem. A visitor badge may be issued to a minor who plans to visit or tour an AGS radiological area. Minors are not allowed to ***work*** in radiological areas.

The following are DOE dose limits prescribed by law. The federal law is known as 10 CFR 835 and is considered the law of the land. That is, these limits are similar to those set for other radiation workers such as those working at commercial nuclear power plants or at hospitals.

ANNUAL DOSE LIMITS		
Dose of Interest	Annual Limit, mrem	Annual DOE Administrative Limit, mrem
Whole Body	5000	2000
Declared Pregnant Worker	500 in 10 months	-
Lens Of The Eye	15,000	-
Hands, Forearms, Feet, or Lower Legs	50,000	-
Any Individual Organ (Not Lens of Eye) Or Skin	50,000	-
Minors, Students, Untrained Visitors, and Public	100	-

RADIATION WORK PERMIT (RWP)



All personnel entering any radiological area at the ion accelerator complex must follow the requirements of the C-A Radiation Work Permits (RWPs) for work in radiological areas. RWP provides a mechanism to document the work review process involving radiation hazards. RWPs are required for the following:

- Any work requiring access to Radiation, High Radiation, Very High Radiation, Contamination, High Contamination, or Airborne Radioactivity Areas.
- Any work involving handling material with radioactive contamination exceeding the levels specified within the Radiological Controls Manual.
- Any work involving handling dispersible radioactive materials exceeding 1% of the materials Annual Limit on Intake (ALI).

Permits should be reviewed when you first enter the area. *General RWPs* are used to control routine and repetitive activities in areas that are radiologicaly stable. *Job Specific RWPs* are used to control non-routine activities, activities in environments with changing radiological conditions, work in High Radiation Areas or activities that require dose tracking.

- General RWPs require signature on a RWP Sign-In Log. Signing the log allows individuals access to the specified areas throughout the duration of the permit.
- Job Specific RWPs apply to specific individuals for all jobs in High Radiation or Contamination Areas.
- All jobs in a Radiation Area predicted to cause greater than 20 mrem to an individual shall require a RWP.

- All Jobs in a Radiation Area predicted to cause greater than 200 person-mrem to the work crew shall require an RWP.
- Persons named on the job-specific RWP must read and sign that they are aware of the requirements.

TLD BADGE RULES

- You May Not Wear Someone Else's TLD Badge
- Unless Otherwise Arranged, Users Are Reissued TLD Badges Each Month And Must Sign For Each New Badge At The C-A Training Office
- Return TLD Badges To The TLD-Badge Board Next To The C-A Training Office In Building 911 When Not In Use
- There Is A Separate Board For User's Badges And Badges Are Arranged Alphabetically
- Wear TLD Badges In "Radiation Areas"
- SECONDARY AREAS Labeled:

"*High Radiation Areas With Beam On*"
Revert To:
"*Radiation Areas*"
When The Gate Is Opened --
Since Beam Is Off, You May Enter The Area If You Wear Your TLD Badge

- If You Lose A Badge In A Radiation Area, Even For A Few Hours, Then Notify The C-A HP Office Immediately
- Return TLD Badges Before TLD-Badge Change Day Which Is The First Saturday Of The Month

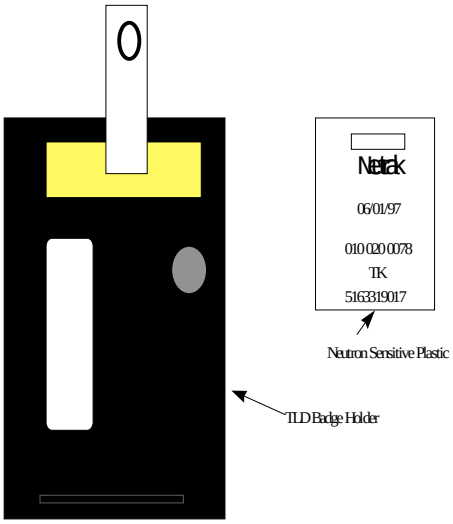
TLD badges detect exposures and verify the effectiveness of the C-A radiation protection program. Currently, TLD badges are read by the BNL Radiological Controls Division and results are back after a few weeks. The neutron-plastic packs attached to the TLD badges are read by Landauer Corporation and results are back after 8 weeks. TLD badges are changed the first Saturday of the month. Emergency TLD-badge read-out can be turned around immediately.

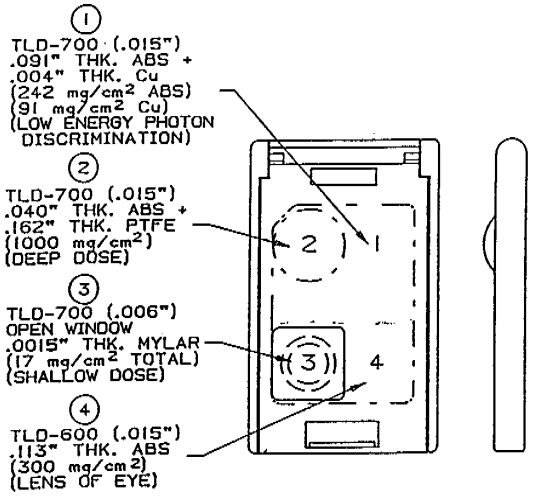
Every employee has a right to know their current accumulated dose. Monthly and cumulative dose for the year can be viewed on the C-A ESHQ web site. A copy of the dose record can be obtained through the C-A FS representative.

Occupational doses received from another facility should be reported to the FS representative to ensure your dose records reflect your current year's occupational exposure and reduce the possibility that you may receive exposure in excess of the annual limit.

Dose received from nuclear medical procedures are not included in occupational dose, but may affect the dose registered by your TLD. The FS representative should be notified prior to such a medical procedure so appropriate occupational dose monitoring protocol can be established.

Wear TLD badges on your torso and outside of your clothing.





Two neutron-sensitive plastic-badges are attached to the TLD badge-clip during running periods. These plastic badges record another estimate of neutron dose by interacting with a broader spectrum of neutron energies, which is different from that seen by the TLD. TLDs are set up to record low-energy neutrons and tend to overestimate the neutron component of dose at AGS. The neutron plastics from Landauer record the high-energy neutrons produced at AGS; thus, one can interpret the neutron dose accurately.

TLDs record >5 mrem per month, and neutron-plastic badges record >30 mrem per month. The accuracy is ± 20% for gamma and worse for neutrons. Do not expose the badge to heat, get it wet, take it home, wear it under your clothes or tamper with the TLD or plastic badges from Landauer. Hang the TLD up on the badge board when you are not wearing it. The accuracy of the exposure data is dependent on proper care and use.

The AGS Experimental floor is at a minimum a Controlled Area, TLD Required. TLD badges must be worn at all times. Shield tops and secondary areas on the

experimental floor are labeled "High Radiation Area With Beam On," and you are not allowed entry even if you wear your TLD.

You may not remain inside a secondary area gate IF the enclosure is labeled "High Radiation Area With Beam On" AND the gate is closed AND the area is reset for beam.

IF secondary areas are labeled "High Radiation Area With Beam On" AND the gate is open, THEN the area is a "Radiation Area" similar to the rest of Building 912. The use of a single sign with the words "With Beam On" allows C-A to efficiently control access to the area without having to change signs each time a secondary area is opened.

TLD BADGES FOR VISITORS

- Visitors Are Those Persons Who Are Visiting – They Are Not Expected To Work
- A Red-Stripe TLD Is Issued To Visitors For A Limited Period AND Cannot Be Re-Issued
- An Escort Is Required At All Times For Red-Stripe TLD Visitors

A visitor's badge is obtained from the C-A Training Office or from the MCR during off-hours. In order to obtain non-escort status, attendance at Radiation Worker 1 Training and Users Training or Special AGS Users Training are required.

A visitor TLD can be issued to untrained people with the approval of the C-A ESHQ Division Head, and it is good if the exposure is planned to be less than 25 mrem. A visitor with a red-stripe TLD is required to be escorted by a trained Rad Worker at all times.

Question: two students have just arrived from off site and you need them to help unpack equipment in Building 912. What do you do?

Answer: contact the C-A ESHQ Division Head to help them obtain red-stripe visitor TLD from the C-A Training Office. You must escort them at all times they are inside a Radiation Area. It is best to get the person trained as soon as possible. Training materials are available in the C-A Training Office.

LOST AND UN-RETURNED BADGES

Please report a lost badge to the C-A Training Office or the HP Office. If a badge leaves the site inadvertently, please mail it back to the Radiological Controls Division, Building 535A, Upton, NY 11973.

Recently a lost badge belonging to a User who worked inside a secondary beam line had results as high as 7,000 mrem. The badge was later determined to have fallen off the User's shirt and to reside for several hours on top of a spectrometer magnet while the beam was 'on' but without any person present.

After the running period was over and the User left for his university, the badge results were reported to C-A. The User later recalled that one-day during the run, he found his TLD badge on top of a spectrometer magnet when he moved across it in order to reach his detectors. He put the

badge back on and performed his work; not aware the badge had likely fallen off during a recent prior entry. He indicated his badge was likely to have been missing for only a few hours during his three-month stay at AGS.

The Access Security computer records for the running period showed that this User had indeed made multiple entries during any given shift. This gave credence to his explanation that the badge fell off and was recovered a few hours later. Dose rates at the top of the spectrometer magnet where he was working were several rem per hour during normal running, but were zero when the beam stops were inserted.

The C-A computer records showed the User employed a secondary area gate for each entry, that the beam stops were closed for each entry, and that a specific gate was used for each entry.

The bottom line was that the User followed the rules and entered the area safely each time; thus, ensuring the beam stops were closed. The only problem was the badge had fallen off between entries.

IF you think you may have lost your badge in a Radiation Area, even for a brief period, THEN please notify the HP Group (x4660). This information will help if we have to reconstruct events following an abnormal badge reading, although computer records of security system actions and area dose rates are also available to us.

In the past few years, the C-A HP office has conducted several hundred investigations for un-returned badges. The work-force cost of these investigations was estimated at $10,000. These investigation costs have been substantially lower than those of prior years, and we feel it was due to your cooperation. However, it could be reduced to zero cost. Please continue to leave badges at the assigned station or rack at the end of your workday or shift. Do not take them outside the Laboratory. Most un-returned badges are the result of AGS Users taking them off-site. Often they are not returned at the conclusion of an experimental run. Your continued cooperation in eliminating this practice is appreciated.

SELF READING DOSIMETERS

Always:

- Log all measured dose.
- Wear on your torso outside of clothing.

Digital dosimeters are:

- Easy to read.
- Chirping function warns of dose rate.
- Alarming function warns of high dose rate.
- Required in order to enter or work in High Radiation Areas.

The purpose of self-reading dosimeters is to allow personnel to monitor their own exposure and compare it to the daily C-A

Administrative Limit of 100 mrem. Self-reading dosimeters have ± 20% accuracy for gamma. They only respond to gammas. They are not calibrated to measure neutrons.

You should always:
Check the dosimeter before using it.

- Read it and zero it out before going into a High Radiation Area.

If the dosimeter shows an unexpected high or full-scale reading, then notify the RCTs (x4660). Your TLD badge should be read-out immediately.
A digital dosimeter electronic dosimeter is required to work in High Radiation Areas. Digital dosimeters have threshold alarms, which can be set to warn the wearer if he or she is approaching an Administrative Dose Limit.

Question: is an alarming dosimeter required whenever you work in radiation levels greater than 1000 mrem per hour?

Answer: yes, for working in the area, but it is not required when you are quickly traveling through one of these areas.

Dosimeter data is recorded on the Contamination and High Radiation Sign In Log distributed at primary gates, and collected each week. The dosimeter data is reviewed by RCTs each week. Make sure you enter ALL your exposure for the day into the dosimeter (SRD) portion of the log. The C-A ESHQ Division will notify your Experimental Spokesperson if you are approaching a C-A Administrative Dose Limit.
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CONTAMINATION

Contamination problems develop from time to time at the AGS; however, successful efforts have been made to design-out target problems and air activation. The past two years have seen the successful operation of high intensity targets. The AGS is also monitoring the target temperature, and the air near the target itself for airborne radioactivity. Contamination events from target failures seem to be under control. However, contamination from working with dispersible radioactivity is still possible if you are cutting or grinding an activated item, or if you encounter smoke or liquid spills in an Activation Area.

Radiation instruments, used to “frisk” materials and personnel, are placed at target cave gates that are known to have modest levels of contamination. If you are not trained as a Contamination Worker, then you cannot not *work* in areas that are labeled "Contamination Area" or “Radiological Buffer Area”. However, you may be escorted by a trained Contamination Worker under certain circumstances. Upon exiting the area you will be “frisked” to check for contamination. If contamination is found follow the instructions of your escort. The escort will contact the C-A ESH&Q Division Head (x5272, pager 4820), or ES&H Coordinator (x7200, pager 5605 or x 7036, pager 6152) and the C-A Health Physics Office (x4660, pager 6189).

Inadvertent skin or clothing contamination is a reportable DOE occurrence. The total number of reportable occurrences is a performance indicator that C-A must track as required by contract with DOE. We are obligated by contract to try to reduce the annual number of occurrences.

Contamination incidents involving ingestion, inhalation, skin or street clothes are avoidable if you follow the rules that are posted in these areas.

ACTIVATED MATERIALS RULES

Under no-beam conditions, primary and secondary experimental areas normally do not present a significant radiation hazard. However, neutron, beta and gamma sources are occasionally stored in these areas. Some detectors contain uranium or other radioactive materials. A few shield blocks on the experimental floor are activated; that is, they have been made radioactive by the beam, and these blocks are marked with radiation symbols and the word "RADIOACTIVE."

Labels For Shielding

- Large concrete and steel blocks: colored radiation symbols with the word "RADIOACTIVE" are painted on blocks and plates to indicate the maximum level of radiation 12 inches (30 cm) from any surface:

Green	< 5 mrem/h
Yellow	5 to 100 mrem/h
Red	>100 mrem/h

- Lead bricks, small concrete and steel blocks: the ends of these items are painted with the appropriate color.

At the AGS, Users might encounter areas that contain activated materials: 1) the primary areas, 2) Radioactive Materials Work Areas; for example, the block yard. Small Radioactive materials that cannot be labeled with the words "Radioactive " may be color coded in green, yellow, red.

ALARA dictates that personnel are aware of ambient radiation levels, but the C-A does not label all materials that enter the radioactive waste stream. Instead, the general radiation-level reading from a pile of waste is appropriate and is the usual posting used prior to packing it in waste bins. The Department tries to repair, remove or downgrade labels on activated items whenever appropriate.

Targets, flags, target holders, or any other objects that are exposed to primary beam may become highly radioactive and may have to be handled with special care in order to avoid excessive and unnecessary exposure.

ACTIVATION CHECK REQUIRED

- This posting means you **must not** release items from the area without checking for activation.
- Contact the HP Office to perform the activation check.
- Activation check has nothing to do with checking yourself for contamination.

In order to remove activated items from the AGS primary areas, a person must have an RCT do the Activation Check before removing the object from the primary area or from your control. Activated equipment must be properly checked and tagged before it is handled by others at BNL.

NOTE:
Only you can prevent unlabeled radioactive materials from leaving the primary areas. Ordinary items inside primary areas do not bear labels. They could find their way into offices, experimental-areas or waste streams unless you follow the rules.

Any shipments of material off-site must be checked in order to ensure proper packaging and labeling if it is radioactive. Off-site shipping of radioactive materials must be coordinated with the Isotopes and Special Materials Group (x4051).

Question: you wish to remove equipment from a primary area to a Radiation Area where you will perform maintenance on it. What do you do?

Answer: call an RCT (x4660) to perform an activation check

Question: what does the posting "activation check required" mean?

Answer: upon exiting a radiological area, personnel must have a RCT check each piece of non-personal equipment that they remove from the cave for "activation." Do not confuse this with "contamination check required" which means each person must "frisk" his or her hands and feet to check for loose radioactive material and have a RCT check for dispersible radioactive material.

RADIOACTIVE MATERIAL AREAS

IF you did not bring it into a Radioactive Material Area and you want to bring it out, THEN you must have it checked for activation; e.g., tools you may find.

Many small radioactive parts may be generated inside Radioactive Materials Areas and they will not bear any labels, although the original assembled item may have a label. Only RCTs may release items from these areas.

Question: true or false - only RCTs may monitor and label items for removal from Radioactive Materials Work Areas.

Answer: true. Contact the RCT (x4660) to make these measurements..

RADIATION SOURCES

Beta, gamma and neutron sources produce radiation levels that may travel many feet in air. The radiation level drops rapidly as the inverse square of distance. This is because most sources are point-like objects. Sources may be stored in shielded containers. Many secondary areas have two or more source boxes since several different Users groups may employ the same beam-line in their studies. If you are using a source in your work, then the following rules apply even if you obtained the source from another BNL Department or Division:

- Please have all sources leak-checked every six months by the C-A HP Office.
- Notify BNL's Isotopes and Special Materials Group prior to shipping a source to or from BNL (Contact the BNL IS&M Group at 631-344-4051).
- Complete the sealed-source inventory procedure and keep it with the source available from the C-A Source Custodian (x5636).

If you are responsible for a sealed source, then DOE Orders and Federal Law require you to keep track of it in a way that can be audited by the Federal government. Additionally, you must be a trained and qualified "Source Custodian." Contact the C-A Source Custodian (x5636) for training. The Federal rules define sealed sources as any radioactive item manufactured for the sole purpose of using the emitted radiation. A common example of a sealed source is an instrument calibration source. THE FOLLOWING ARE NOT SEALED SOURCES: smoke detectors, exit signs, activated beam-line components, activated shields, radioactive materials in-process such as targets or cooling waters.

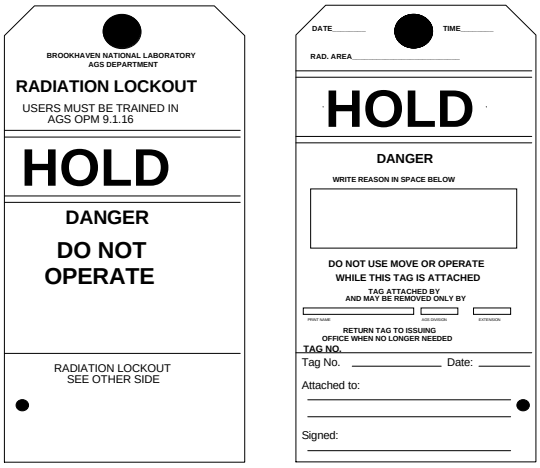
If you are not sure about the definition of a sealed source, then contact the HP Office (x4660) in order to make a determination regarding the rules.

The HP Office has custody of a limited number of beta and gamma emitting sources. These are available to be loaned as needed.

Care should be taken to ensure that sources are not lost or damaged, as this might result in unnecessary exposure and widespread contamination. Sources may not be moved into an uncontrolled area or away from the

AGS complex. The HP Office must be contacted if sources are to be moved.

RADIATION SAFETY LOCK OUT AND TAG OUT (RS LOTO)



COLOR OF TAG IS RED

Liaison Physicists, Liaison Engineers, and members of the Radiation Safety Committee must follow a specific procedure in order to lock out and tag out equipment or beam lines for radiation protection. Equipment or beam lines are generally locked out during barrier modifications or removals, or whenever the security system alone does not provide the required protection. This lockout is required in order to limit beam parameters such as polarity and intensity, or whenever a beam line is not authorized to operate.

DO NOT alter or otherwise tamper with equipment that bears the RS LOTO tag. Never REMOVE any RS LOTTO tag.

ACCESS SECURITY SYSTEM ORANGE TAGS

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- Program disruption and/or electrical shock may occur by overlooking an orange warning tag.
- Tags and signs are often placed only on the front of equipment.
- Look at the front of equipment before starting work.

The devices sensed by the access security system must remain correctly connected. In order to help ensure that Users do not disconnect or alter these devices without following the approved procedure, the Access Controls Group has identified about 150 devices with an ORANGE WARNING TAG. Additionally, most of the Security System wiring is maintained at 120 VAC and is an electric shock hazard.

In the experimental areas, these tags alert personnel that the device is critical to safe operation of the Security System. Scintillation detectors called NMCs (Nuclear Measurements Corporation) and chipmunk radiation monitors are part of the

security system. DO NOT MOVE these devices since relocation will compromise their effectiveness.

Question: a power supply switch must be replaced and you want to disconnect all power to the supply. You encounter a circuit labeled with an Orange Tag and you want to disconnect it. What do you do?

Answer: follow instructions on the tag and get authorization to disconnect the circuit.

INTERLOCK BYPASS

- Never take it upon yourself to bypass any interlocked system.

Interlock bypassing can only be done at the discretion of the C-A Radiation Safety Committee. Proper authorizations must be obtained prior to the bypass. The protection offered in lieu of the interlock must be equivalent, and this requirement is met by having the pertinent Liaison Physicist and the Radiation Safety Committee Chair review and approve the bypass.

RED TAGS

Lockout/tagout (LOTO) is used everywhere at the Laboratory for personnel safety for energy sources other than ionizing radiation. You recognize it by the presence of a red tag and a lock, and you must obey specific OSHA requirements. In some cases, the equipment cannot be locked and only the red tag is used. In most cases, however, LOTO boots or other commercially available locking devices can be added to the device to enable complete LOTO. Contact the C-A ES&H Coordinator (x 7036, pager 6152 or x7200, pager 5605) for more information.

To prevent accidental radiation exposure, electrical shock or other hazards from different sources of energy, the LOTO shall only be removed by the individual who attached it. When the individual who attached the LOTO is not available, a committee of three employees must be formed, and the membership of the committee is designated by C-A procedures. These persons will be familiar with the area or equipment under the LOTO and they shall determine if it is safe to remove the red tag and lock. Contact the MCR or the C-A ESHQ Division Head (x 5272) if you need to remove someone else's LOTO. A similar procedure is used for Radiation Safety (RS) LOTO.

All personnel that work on electrical circuits that have been powered and are controlled by circuit breakers, disconnect switches and/or fuses must LOTO the circuits. OSHA, BNL and C-A require that all workers performing these tasks be trained in LOTO. If you or members of your collaboration fall into this category, then contact the C-A Training Manager (x7343) for training.

Question: a red tag is on a piece of equipment. You need to operate the equipment, what do you do?

Answer: contact the C-A ES&H Coordinator (x 7036, pager 6152 or x7200, pager 5605)

CHIPMUNKS AND RADIATION SURVEYS

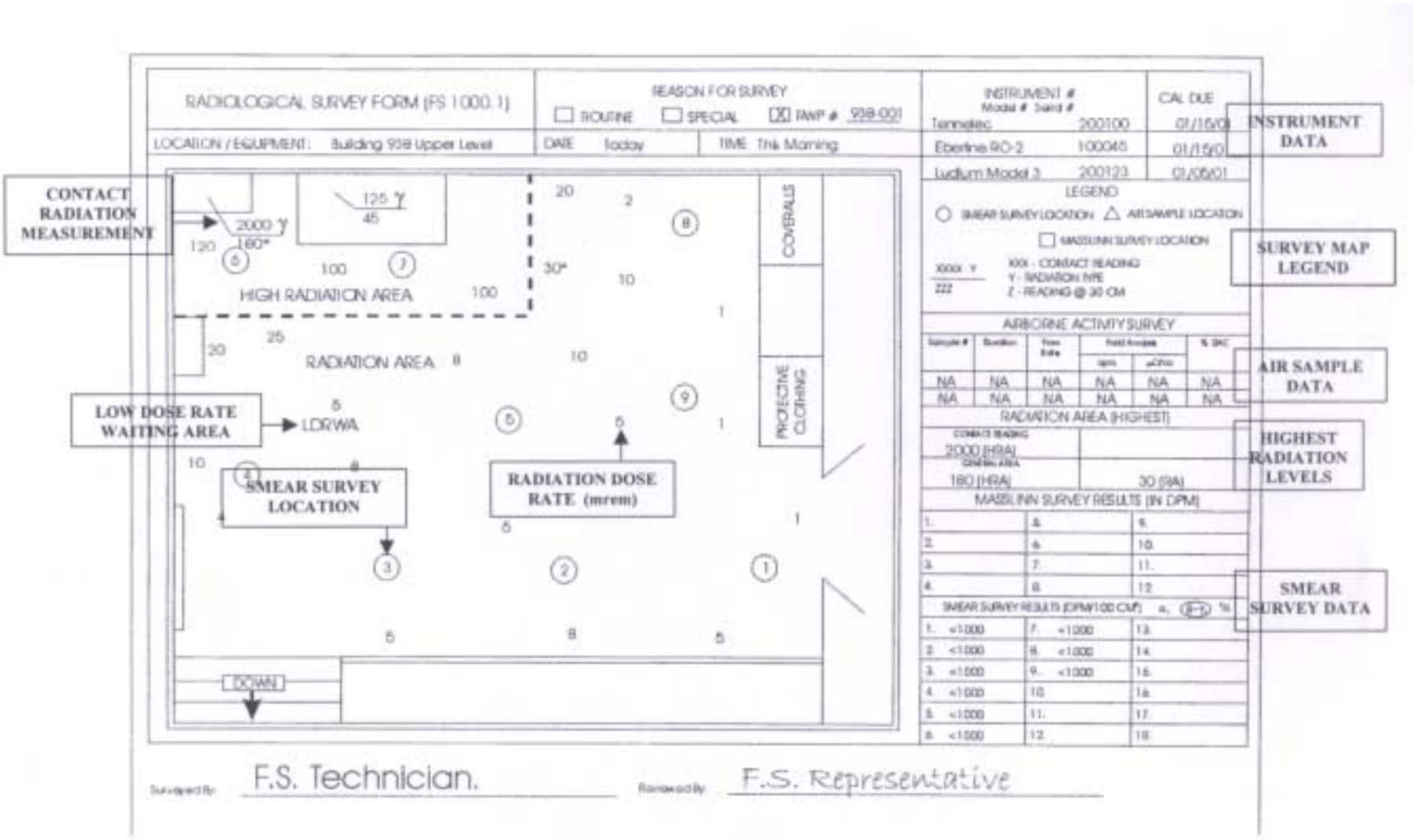
RADIATION MONITOR (CHIPMUNK)

During a running period, radiation surveys are updated daily, and continuous area monitoring is performed by instruments, called Chipmunks, which alarm in the Main Control Room. In addition, during running periods, daily radiation surveys of the experimental floor are made by HP technicians. During shutdowns, surveys are done initially, and whenever an RWP is used. Records of the surveys are maintained by the C-A Health Physics Office.

Survey data is normally attached to the permits and copies are maintained at the job site.

Radiological surveys are performed to evaluate the radiological conditions of the work area and contain an assortment of information. Information on the radiological survey includes:

- General Area (whole body) radiation dose rates
- Contact (extremity) radiation dose rates
- Surface contamination survey (masslinn and smear) data
- Airborne radioactivity data
- Low Dose Rate Waiting Areas (LDRWA)


RADIOLOGICAL SURVEY FORM (FS 1000.1)
REASON FOR SURVEY
ROUTINE
SPECIAL
RWP # 938-001
LOCATION / EQUIPMENT: Building 938 Upper Level
DATE Today
TIME This Morning
INSTRUMENT # Model # Serial #
CAL DUE
Tennelec 200100 01/15/01
Eberline RO-2 100045 01/15/01
Ludlum Model 3 200123 01/05/01
INSTRUMENT DATA
CONTACT RADIATION MEASUREMENT
HIGH RADIATION AREA
RADIATION AREA
LOW DOSE RATE WAITING AREA
LDRWA
SMEAR SURVEY LOCATION
RADIATION DOSE RATE (mrem)
COVERALLS
PROTECTIVE CLOTHING
DOWN
LEGEND
SMEAR SURVEY LOCATION
AIR SAMPLE LOCATION
MASSLINN SURVEY LOCATION
XXXX Y / ZZZ
XXX - CONTACT READING
Y - RADIATION TYPE
Z - READING @ 30 CM
SURVEY MAP LEGEND
AIRBORNE ACTIVITY SURVEY
NA NA NA NA NA NA
NA NA NA NA NA NA
AIR SAMPLE DATA
RADIATION AREA (HIGHEST)
2000 (HRA)
180 (HRA)
30 (RA)
HIGHEST RADIATION LEVELS
MASSLINN SURVEY RESULTS (IN DPM)
SMEAR SURVEY RESULTS (DPM/100 CM²)
SMEAR SURVEY DATA
Surveyed By: F.S. Technician.
Reviewed By: F.S. Representative

Radiation Monitors (Chipmunks)

The Chipmunk is set up like a street light with red, yellow and green indicators. A chipmunk will display a red blinking light for radiation levels greater than 20 mrem/h, and a yellow blinking light for levels greater than 2 mrem/hr.

Chipmunk readings are also recorded continuously and maintained in a database for later retrieval and review. Chipmunks are capable of alarming locally and are stationed at fixed locations in order to monitor high occupancy areas and other areas of interest.

Retrospective exposure rates for any area of interest can be determined by the staff at the C-A HP Office.

There are approximately 100 chipmunk-monitoring devices in use at this time. They have pre-designated alarm levels established by the Radiation Safety Committee. Main Control Room Operators are trained to respond to alarms and investigate the cause, even if it means interrupting the physics program.

RESPONSE TO ABNORMAL RADIOLOGICAL CONDITION:

CRASH BUTTONS / CRASH CORDS

- IF the overhead lights go out while you are in the primary areas, THEN hit the crash button since beam is imminent.
- Crash buttons are red and mushroom shaped. Doors have crash bars.

- Orange crash cords are mounted on the tunnel walls in the U-V, V Target and upstream W lines, BUT the lights DO NOT go out when beam is ready. INSTEAD an alarm will sound for 30 seconds and red-flashing strobe lights will illuminate the area.
- IF you observe a visual warning, THEN, start for the nearest crash button, or start for the crash cord, or start for the exit.
- If the lights go out, then do not assume it is a power failure.
- DO NOT PANIC, you have time, 30 seconds minimum.
- Hitting crash buttons or opening doors will turn lights on.

Pressing crash buttons causes the beam stops to insert, lights to go on, and interrupts electrical energy to the main magnet bus and RF devices. Crash buttons are located at several locations in the muon-storage-ring area of Building 919, and along the primary beam lines. There are also crash buttons located in several secondary beam lines. They are labeled with a red sign.

Orange crash cords are in use in the AGS to RHIC Transfer Line (AtR). Pulling a crash cord causes the beam stops to be inserted.

One can always crash into or out of any primary area. Pushing the crash bar on primary gates in Building 912 will cause the lights to go on and beam to be inhibited. After pushing a crash button, crash cord or crash bar, call the MCR and notify them where you are located.

Question: if the light goes out in an AGS primary area, should it be assumed that loss of electrical power occurred?

Answer: it should be assumed that the lights have dimmed in order to signal that lethal hazards are imminent. You should press the nearest crash button in order to turn the lights on and disable beam.

ABNORMAL RADIATION LEVEL

IF you encounter either of the following conditions:

- Radiation levels not anticipated on your RWP.
- Unexpected high or full-scale dosimeter readings.

THEN stop work, alert your Liaison Physicist or Experiment Spokesperson and contact Health Physics (x4660) as soon as possible.

EMERGENCY DOSE FOR RESCUE OR RECOVERY

All persons must follow the instructions of the Department Emergency Coordinator (DEC) who is the Operations Coordinator during operations. During shutdown periods and maintenance periods, the C-A ES&H Coordinator is the DEC. IF an emergency requires rescue of personnel and involves substantial risk, THEN volunteers may be selected based on their age, experience and prior dose history. These rescues are to be pre-planned activities and are not to be "heroic efforts to save a friend." The DOE and BNL emergency dose limits are:

- 10 rem for protecting major property where the lower dose limit of 5 rem is not practicable.

- 25 rem for life saving or protection of large populations where the lower dose limit is not practicable.
- 25 rem or greater is allowed only on a voluntary basis and only when a person is fully aware of the risks involved.

RADIATION SAFETY SERVICES

- Contact HP Office.
- Pager 6189 (Digital Pager).
- Phone 4660.

The Radiological Controls Division (RCD) provides the C-A with services that encompass several operational aspects of safety including radiation safety. They provide dose records and radiation surveys, HP coverage for high-dose jobs, and review of RWPs for ALARA. They also assist in re-setting secondary beam lines, and assist in interpreting abnormal radiation levels. If you have radiological concerns that you desire to communicate in writing, you may complete a Radiological Awareness Report available through your Liaison Physicist, or HP representative.

During running periods, HP coverage is provided on all shifts. During shutdown, services are provided from 8:30 a.m. to 4:30 p.m., Monday through Friday. Assistance is obtained by contacting the HP Office (x4660), or pocket pager 6189 (digital pager), or by contacting the C-A MCR (x4662).

Special shifts for RCTs may be pre-assigned allowing for specific round-the-clock coverage when needed during a shutdown. A few weeks advance notice should be sent to the RCD Representative (x4882) for special HP coverage.

COMPRESSED GAS SAFETY

ALL COMPRESSED GASES ARE HAZARDOUS DUE TO HIGH PRESSURE.

COMPRESSED GASES **MAY ALSO** BE HAZARDOUS **BECAUSE THEY *ARE*:**

TOXIC: Gases that are poisonous in varying degrees ranging from extremely dangerous to life to only an irritant. Exposures to the more toxic gases can cause severe illness or death. Typical examples of poisonous gases are Carbon Monoxide and Hydrogen Sulfide.

FLAMMABLE: A condition that results when even small quantities of a specific gas when mixed with air forms a mixture that is capable of being ignited. Once ignited, the burning gas mixture can ignite other nearby combustible materials. Typical flammable gases are Acetylene, Hydrogen, and Methane.

CORROSIVE: Corrosive materials can cause visible destruction or irreversible injury to human skin and eyes (similar to a burn) at the site of contact or can cause serious degradation of various construction materials, such as steel, or brass. An example of a corrosive gas is Chlorine.

OXIDIZERS: A gas that supports or enhances combustion. These gases must be handled with caution since they increase the potential of fire or explosion. They require special storage considerations. Typical oxidizer gases are Oxygen, Chlorine, Fluorine, and Nitrogen Oxides.

ASHYXIANT (oxygen displacement): Asphyxiation is a condition which results when a gas reduces the concentration of breathable oxygen to a hazardous level in air by displacing and diluting normal air. Typically all gases other than oxygen and air can do this.

CYLINDER RECEIPT AND CONTENT IDENTIFICATION

Because of the different hazards associated with different gases, it's important that cylinders be properly labeled. When a cylinder is delivered to the gas warehouse, a laboratory, or a job site, it should have (1) content identification by stenciling or labels, the personnel at the BNL Gas Warehouse will Attach a Cylinder Status Tag on the cylinder when it is delivered , 2) DOT label, and (3) a valve protection cap. **UNDER NO CIRCUMSTANCE** should the means of identification be removed from a cylinder. The valve protection cap should remain in place until the user has secured the cylinder to a fixed support at the point of use and is ready to attach a pressure regulator to withdraw the contents.

Sometimes cylinders are received with no identification other then color code. There is no uniformity in the identification of cylinder contents through color coding of the cylinders. **Under no circumstances should such cylinders be accepted.**

DOT labels have a minimum of precautionary handling information and will classify the cylinder contents.

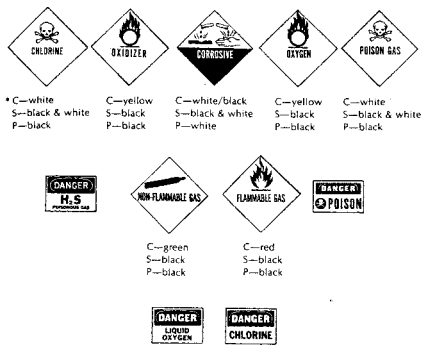
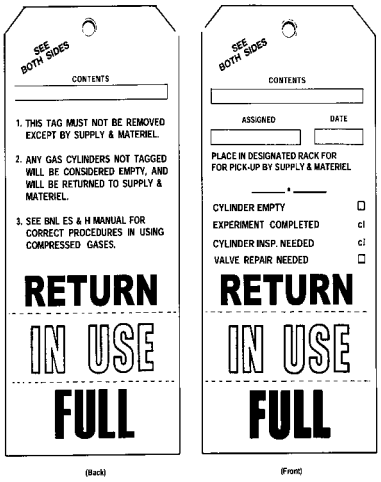


Figure IV–1
Safety Signs

The personnel at the BNL Gas Warehouse will attach a Cylinder Status Tag on the cylinder when it is delivered.



GENERAL RULES FOR CYLINDER HANDLING

- Do not drop cylinders or permit them to violently strike each other
- Do not roll cylinders in a horizontal position
- Do not drag cylinders
- Do not handle cylinders with oily hands or oily gloves (This is especially important when handling oxygen and other oxidizers)
- If hoisting is necessary, use a suitable cradle or platform
- Do not lift a cylinder by its cap
- Keep cylinder caps on the cylinder whenever they are not in use
- Transport cylinders using a cart or hand truck designed for that purpose
- Whenever placing a cylinder in service, check the hydrostatic test date (5 year max between dates)
- Tear off the bottom of the Cylinder Status Tag and write name of assigned user on tag indicating the cylinder is in use

COMPRESSED GAS CYLINDER SAFE STORAGE

- Storage areas should be dry, cool , and well ventilated, and where practical, fire resistant
- Gases of different types are to be grouped by type and non-compatible types should be separated. Flammable gases shall not be stored with oxidizing gases.
- Cylinder storage areas are to be prominently posted with the types of gases stored
- Charged and empty cylinders should be stored separately. Cylinders should be arranged so that old stock can be removed first with a minimum handling of other cylinders

- Cylinders should not be stored at temperatures above 125 ^{0}F, (52^0 C) or near sources of heat.
- Cylinders should not be stored near highly flammable or combustible materials
- When cylinders are being moved on a cylinder cart, they must be secured to the cart

SECURING CYLINDERS

Safe methods for securing capped compressed gas cylinders in storage include the three-point contact system. By restraining cylinders in a tight mass using a contiguous three -point system with other cylinders or solid support structure. All compressed gas cylinders shall be secured to prevent falling. An appropriate method for securing cylinders is by providing a substantial chain, which is positioned in front of, or around the cylinder(s) and secured to a solid structure.

OXYGEN DEFICIENCY HAZARDS

What is oxygen deficiency? Normal atmospheric content is 20.9% oxygen, 78% nitrogen, and 1% argon. Oxygen deficiency is defined as less than 19.5 % oxygen. This happens when air in an enclosed space is displaced by another gas.

What causes oxygen deficiency? Cryogenic systems use large amounts of helium and nitrogen. Both liquids expand about 700-800 times when released into air. This could happen quickly with a major release as a result of catastrophic failure. In a major release, one might see a rapidly expanding white cloud and hear a "whooshing " sound. The leak could also be slow, invisible and silent. Both helium and nitrogen are colorless and odorless.

Sulfur hexafluoride (SF_6), a noncombustible, colorless gas, with a slight sulfur like odor. This gas which is heavier than air, is used at the Tandem Van de Graff as an insulating gas. A oxygen deficiency hazard may occur in the event of a large release of this material. Since this material is heavier than air, some low laying areas, basements and pits have been designated as an ODH 0 area.

HEALTH EFFECTS OF OXYGEN DEFICIENCY

The following table summarizes the health effects of oxygen deficiency.

Volume % O	Effect on Healthy Person	Approximate Time
17	Deep Breathing Rapidly Faster Heartbeat	
16	Dizziness, Slower Reaction Time	Rapidly
15	Impaired Attention And Coordination, Intermittent Breathing, Rapid Fatigue, Loss Of Muscle Control	Rapidly
12	Very Faulty Judgment, Inability To Move, Loss Of Consciousness, Brain Damage	10 Min 10 Min 2 Hours
10	Inability To Move, Nausea, Vomiting, Loss Of Consciousness	4 Min 10 Min
6	Loss of Consciousness Coma Death	30 sec 1 min 5 min

CLASSIFICATION LEVELS OF ODH

There are five classes: 0 through 4, with 0 being the least hazardous. Classification is based on the likelihood of ODH. There are no areas at RHIC or AGS with classification greater than Class 1. Two areas, 1005R refrigerator and g-2 refrigerator are Class 1. Additional control measures and training are required for unescorted entry into a Class 1 ODH area.

This access training allows you to enter the following Class 0 areas at AGS:

- g-2 Compressor Building,
- g-2 Muon Ring Storage Building (High Bay), and
- EVA Compressor Room (E850), EEBA Rectifier House #3.

WHEN IS EVACUATION OF AN ODH AREA REQUIRED?

Any one or combination of the following requires an immediate evacuation of an ODH area:

- The in-place oxygen monitors set off an alarm.
- A vapor cloud is observed inside the ODH area or a loud "whooshing" sound is heard (even if no alarm sounds).

The evacuation procedure is as follows:

- Leave the area, moving away from any vapor cloud or other potential problem.
- If someone is in danger, hurt or feeling ill, call 2222 or 911. Otherwise, call the Main Control Room.

It is important to remember that you should not re-enter even with an escape pack. Let the Fire/Rescue Group handle it. ODH deaths usually come in pairs; more than 50% of ODH deaths are of would be rescuers. One or two breaths could cause loss of

consciousness under certain conditions, and lung damage is possible if the gas cloud temperature is -50 to -70 ºC.

STOP WORK IMMINENT DANGER PROCEDURES

This procedure provides a policy and process to stop work at BNL to mitigate ***imminent danger*** to personnel, equipment or the environment. ***Imminent danger*** exists when there is a hazard that could result in death, serious injury, environmental impairment or significant damage, and when **immediate action is required**. The person issuing the stop-work order makes determination of the need for immediate action.

Anyone who will be given unescorted status in a facility must first be trained in this procedure. **Only persons trained in this procedure have stop-work authority**. For example, casual visitors to BNL and other untrained individuals do not have this stop-work authority. Persons who are not trained for unescorted access are still expected to call attention to any questionable or unsafe act or condition. Management shall take such notification seriously and make an evaluation.

Laboratory managers and supervisors shall not allow hazardous work to be started unless the involved worker(s) are trained and qualified in this stop-work procedure.

BNL functional organizations on the BNL Organization Chart (e.g., Departments, Divisions, Offices, Projects, etc.) shall be referred to as Departments for the purpose of this procedure.

Persons trained in this procedure are responsible for and expected to issue a Stop-Work order for ***imminent danger*** whenever it is observed. Each Department shall train all staff under their direct supervision in the provisions of this procedure. If an employee is reassigned to work for another supervisor for a period of time, the new supervisor must ensure facility specific stop-work training is conducted prior to allowing work to commence. Each Department is responsible to integrate and document stop-work training for employees, guests, and users who will be granted unescorted access within facilities under their purview. The training shall include discussion of applicable Department-specific stop-work examples of ***imminent danger***.

Requests to change this procedure must be forwarded to the BNL Laboratory Director.

This procedure is used to stop work when conditions that are interpreted to constitute imminent danger occur. **Other procedures shall be used to prevent people from taking unnecessary risks with lesser hazards or for stopping radiological work.**

Any person who reasonably concludes that an ***imminent danger*** exists and that immediate action is required to mitigate the danger is obliged to take action to stop work. An ***imminent danger*** exists if proceeding with work could result in death, serious injury, or significant unexpected environmental or equipment damage. A person who concludes that an ***imminent danger*** exists must consider whether stopping work immediately or proceeding to a safe stopping point constitutes the greater danger.

Procedure

1. The initiator of a Stop-Work order for ***imminent danger*** shall state the following:
   "Stop work! You are in imminent danger because…"

2. Any person receiving a Stop-Work order shall stop work immediately, if that can be done safely, or at the first opportunity to stop safely.
3. The person issuing a Stop-Work order MUST NOT verbally or physically interfere, whether or not the recipients of the Stop-Work order continue to work.
4. After the work is stopped, the recipient of the Stop-Work order shall notify his/her supervisor (Liaison Physicist) and his/her ES&H Coordinator that a Stop-Work order was issued, and of the nature of the ***imminent danger*** that exists.

Notifications

The person initiating a Stop-Work order shall identify him/herself to the affected workers as soon as it is safe to do so. In turn, the supervisor of the involved work shall notify his departmental management.

If the person issuing the Stop-Work order feels that the recipient(s) of the order failed to take appropriate action, then the initiator of the Stop-Work order shall notify his/her own supervisor (Liaison Physicist) and the C-A ES&H Coordinator (x3271, pager 4210). If more than one Department is affected by the Stop-Work order, then the person initiating the Stop-Work order shall notify the C-A ES&H Coordinator and the ES&H Coordinator of the other Department.

The supervisor and the ES&H Coordinator shall investigate and evaluate the need for further action or internal or external reporting. Management shall resolve appropriate issues in cases where the recipient of a stop-work order is not compliant with this procedure. There will be no reprisals by anyone for issuance of a stop-work order.

Following a stop-work order, the AGS Department Chair or his designate shall determine, with advice and counsel from ES&H personnel, the conditions that must be met before work may resume. Input into conditions for restart shall also be sought from the person who initiated the stop-work. Work shall not be resumed until appropriate corrective actions and safety reviews are completed and the responsible manager authorizes restart.

Radiological Stop Work Procedure

This procedure provides a mechanism for trained Laboratory employees, guests, and contractors to stop radiological work that does not meet Laboratory requirements or creates the threat of radiological exposures or releases. The Laboratory has issued a procedure for stopping work when conditions constituting "Imminent Hazard" exist. This radiological stop-work procedure utilizes the requirements and process established in the imminent hazard procedure fully, except that different criteria are described for the conditions under which a radiological stop-work order may be given. Because of the nature of radiological work, stop-work criteria are provided for certain situations that would <u>not</u> be considered "Imminent Hazard."

Improvement of radiological performance is a high priority at BNL. All workers trained in the radiological stop-work procedure have the responsibility to improve performance by providing careful attention to his/her performance and to that of co-workers. In support of this procedure:

- Each worker is expected to point out and insure correction of poor radiological work practices whenever they occur. In most cases, all that should be necessary is calling attention to the problem.
- All workers are expected to respond positively to radiological cautions provided by a co-worker.
- There may be situations where a formal stop-work is necessary. Any worker trained on this procedure is authorized to stop radiological work when the conditions defined in Section IV are met.
- All personnel are expected to immediately abide by a stop-work instruction.

It should be noted that the supervisors do not need to invoke a Stop-Work Order in exercising their normal responsibilities to monitor work in progress and to ensure proper adherence to BNL practices.

Whenever poor radiological performance is observed, workers should provide immediate advice to correct the problem**.** In most situations, a formal stop-work is not needed. The concern should be addressed quickly without participation and review by other than the involved workers. The imminent occurrence of the following examples are the types of situations that should be immediately corrected with a cautioning:

- Entry into a Controlled Area without proper training or escort.
- TLD worn on the wrong location on the body.
- Work about to begin without observing expected requirements.
- Removal of material without observing exit survey requirements from a location controlled as a Contamination or Activation Area.
- Beginning work without adequate Work Planning or training qualification.
- Touching the face or other exposed skin while working in a contamination area.
- Survey for radioactivity performed in a hasty manner.
- Disturbance of radiological postings or barriers.

Each of these activities, if not promptly addressed, could lead to a violation of federal and BNL radiation protection requirements.

IV. Stopping Radiological Work

1. Many poor practices can be quickly corrected through the cautioning process before violations occur. There may be occasions when an employee observes a practice that is most likely a violation already, or possesses the potential to result in significant radiological exposure or release of radioactive material. In these situations, the work should be immediately stopped through a formal "Stop-Work" instruction; and follow-up reviews conducted to correct the problem prior to work continuing.

   Examples of this type of situation are:

   - Discovery of work that is being conducted without adequate Work Planning, such as work in a High Radiation Area or a Contamination Area without a RWP.
   - Blatant or repeated disregard of established radiological requirements or direction from a health physics technician.

- Operation of radiation-producing equipment with interlocks bypassed without prior review and approval.
- Radiological controls that are inadequate for work in progress as evidenced by:
    - Unplanned exposures greater than 25 mrem to a visitor or minor, or greater than 100 mrem to a worker.
    - Two or more skin contaminations during any single phase of the work.
    - Any single skin contamination >50,000 dpm/100cm^2 .

2. In these situations, the work should be stopped by any trained individual using the following language. "**Stop work. You are in violation of radiological requirements because ……**"

3. When a stop-work order has been given, the following actions shall occur:
    - All work in the affected activity shall stop as soon as possible.
    - The work place shall be placed in a safe condition.
    - All workers shall report to the responsible line manager.
    - Work shall not resume until appropriate safety reviews are performed and restart is authorized by the C-A Department Chair or his designate, subject to the advice and counsel of the affected ESH Coordinator(s) and the BNL Radiological Control Manager.
    .

REMOVING DAMAGED EQUIPMENT FROM SERVICE

If any equipment presents an immediate hazard that could reasonably be expected to cause serious injury or environmental harm, then you must remove it from service (e.g., broken ladders, frayed slings, defective power cords, leaking tanks).

COUNTER-INTELLIGENCE PROGRAM

The Department of Energy is known worldwide as a stronghold of scientific expertise, and as such, is of prime interest to foreign intelligence services. To help protect it's interests, the DOE established the Counterintelligence Program. All BNL employees are required to report contacts with foreign nationals and all travel to sensitive countries. For information about this program or to report any concerns contact the BNL Counterintelligence Program Manager (x2234).

LABORATORY COMPUTERS

Laboratory computers are provided to staff in order to support Laboratory operations. You must be authorized to work on a computer and use it in accordance with BNL requirements. The BNL Computer Users Agreement defines the acceptable parameters for computer use.

You are responsible for the security of your computer and its stored data. Information created, stored, and processed at BNL is considered BNL property and must be protected. If at any time, you suspect that the security of your computer has been compromised, contact your supervisor immediately.

BNL SECURITY

The Police Group, part of BNL's Safeguards and Security Division, is responsible for providing protection to BNL employees, property, and equipment, as well as controlling sensitive and classified information.

Identification badges, security clearances, and property passes aid in the security process. Photo identification badges are issued to all employees, visitors and guests. ID badges should not be left in the open. If you loose your ID badge contact the Security Division to have another issued.

A property pass is required any time you remove BNL property from the site. BNL reserves the right to inspect and search vehicles entering or leaving the site. For more information about security or if you are required to work with sensitive material contact Security Division (x2238)

STAFFING LEVELS AND SAFETY

Rules shall be followed even when you are short-handed. Do not violate safety rules to get the job done. For example, do not go down one-way streets the wrong way even if you get to the beam-line quicker. Do not climb cable tray because it takes more time to ask for a man-lift. Do not use a procedure that you have not been trained on even if you feel it will please your Experiment Spokesperson. IF you were called in unexpectedly and you were not physically or mentally ready to work, THEN you must request the next person on the call down list be contacted. In short, there are no economics for safety. It will always be cheaper to do the job right the first time. There is only a cost for failure, and experience shows this cost can be spectacular.

OUTDOORS SAFETY CONCERNS

All New York State laws must be followed. The site speed limit is 30 mph. Obey all parking and traffic postings. The deer on site also present a driving hazard to which you should be alert.

On the BNL site you will see a variety of wildlife. Many of the deer and some other animals carry the deer tick, which can transmit Lyme disease. Avoid high grass and wet wooded areas. For more information

about Lyme disease contact the C-A ES&H Coordinator (x 7036, pager 6152 or x7200, pager 5605) or the Occupational Medicine Clinic.

FIRE OR OTHER EMERGENCY

IF you work in a primary area, THEN make a mental note of:

- Exits.
- Fire Alarm Pull Boxes.
- Crash buttons.
- Crash cords.
- Inter phones.
- Emergency exhaust, if any .
- Phones (MCR x4662, Fire/Rescue x2222, x911, or from a cell phone 631-344-2222).

Question: you need immediate help in an emergency. What do you do?

Answer: pull a fire alarm box, call x2222 or x911, or call the MCR x4662. All of these are OK but your best response is to pull a fire alarm box since it will be easier to quickly determine your location, and you simultaneously alert the C-A MCR and the BNL Fire/Rescue Group. Once pulled, you should also try to call x911 to alert them as to the exact nature of the emergency.

Question: there is a fire near your detectors and they contain isobutane, what do you do?

Answer: warn others, pull the fire alarm box and evacuate the building.

In any emergency, one can and is encouraged to pull a fire alarm box; it does not have to be a fire. Fire alarm boxes are located throughout the accelerators and at the entrances to target caves. They are the best method to simultaneously alert MCR and the Fire/Rescue Group. Pulling a fire alarm box brings the Fire/Rescue Group to your specific alarm-box location within two minutes, and appropriate additional personnel can be summoned right away. We note that if it possible to follow up with a phone call, then you should do so.

Rings and caves are of limited space. If fire should break out, then smoke could quickly impair visibility, and asphyxiation from smoke is a possibility. If fire breaks out, then get out immediately. Emergency exit signs will point you to the nearest exit.

Once outside a smoky area, report to the Local Emergency Coordinator (LEC) or the Department Emergency Coordinator (DEC) if they are present. They will be wearing baseball-like caps marked DEC or LEC. Do not chat with the Fire Captain or other emergency response personnel in the area. Obey the directions of the Fire Captain, DEC or LEC.

AGS SIGNALS

Even if you are inside an AGS primary area, then you must obey the emergency signals as follows:
If you hear a Pulsating AGS Klaxon (flammable/explosive gas alarm), Intermittent or Continuous Fire Alarm Bell, evacuate the area after placing equipment in a safe operating mode. The Main Control Room Personnel, Operations Personnel, and Hydrogen Target Watch Personnel must remain on station if they have emergency duties, but will evacuate during imminent danger situations. Personnel will then assemble in the lobby of building 911 (Synder Seminar Room Area)

BNL SITE SIRENS

- IF you hear a continuous site-wide siren for five minutes, THEN leave the area and assemble in the lobby of Building 911.
- IF you hear a pulsating site-wide siren, THEN evacuate the BNL site.

The site evacuation plan covers other facilities on-site including reactors. The site sirens are tested each Monday at noon. If you hear a continuous site siren for a five-minute duration, then assemble in the Building 911 lobby near the Snyder Seminar Room. If you hear an intermittent site siren, then evacuate the BNL site immediately.

Question: if you hear the intermittent fire alarm or a pulsating AGS klaxon, then what should you do?

Answer: assemble in the lobby of Building 911.

Question: continuous sounding of the site sirens for five minutes means what?

Answer: proceed to the lobby of Building 911.

ACTIONS FOLLOWING AN INJURY/ILLNESS

- IF there is an emergency involving a serious injury or an illness such as a heart attack, THEN pull the fire alarm box, and follow up with a call to x2222 or x911 if you can.
- IF you are injured, THEN report as soon as possible to the BNL Industrial Medicine Clinic, which is located in Building 490. Contact your supervisor, if possible, to accompany you to the clinic.

ACCOUNTABILITY FOR NOT FOLLOWING THE RULES

Perform exactly the requirements in AGS procedures or cause those requirements to be officially changed to what the C-A Department needs. This policy applies to all Users and will be enforced everywhere. You will be held accountable to follow rules and procedures for which you have been trained.

FREQUENTLY ASKED QUESTIONS AND ANSWERS

The answers to these questions provide limited guidance and they are intended to help you plan your experiment at the AGS. Consult your Liaison Engineer or Liaison Physicist for more detailed information.

Do I really need to hang my TLD badge up every day?

Yes. TLD badges are required to be left at the assigned station or rack at the end of the workday, and must not be taken outside the Laboratory. TLD storage racks are located in low-background areas in Building 911 near the C-A Training Office. If you leave your TLD badge at the work area or the counting house instead of using a rack, then unwarranted dose may be recorded.

Ninety per cent of the lost badges have been as a result of AGS experimenters taking

them off-site and not returning them, especially at the conclusion of an experimental run. Getting used to putting the badge on the rack at the end-of-shift will help alleviate the problem of un-returned badges.

Does a senior User have to be present during every shift?

During beam operations, all shifts must be staffed by at least one person experienced in operation of the experiment. He or she shall be aware of proper response to alarms and for normal maintenance actions such as change-out of gas cylinders, and alarms for emergency actions. Emergency actions may include closing-off flowing gas or cutting power. Senior Users should also be aware of access controls for the experimental area and operations procedures for the gas-mixing systems if appropriate. In order not to staff the experiment during idle periods, gas flow must be throttled down and high voltages must be reduced.

Do Users need to have written procedures?

The C-A Department conducts its operation using formal written procedures in a style prescribed by DOE Orders. DOE currently desires uniform operations through out its facilities but recognizes that Users must apply a graded approach commensurate with the hazards and programmatic importance of their experiment. Users at the AGS should write down all procedures or protocols with safety implications such as mixing flammable gases, opening/closing vacuum window shutters, or the actions to be followed in an emergency. Users should follow all requirements of C-A sweep procedures if they are allowed to assist in the sweep of their secondary area.

In addition to written procedures, the experimental areas should be orderly and clean at all times. Keep all gas lines, power lines and water lines labeled and in separate raceways. Label all containers of liquids. Keep combustible materials to a minimum.

Do all changes to an experiment need to be brought before the C-A Experiment Safety Review Committee?

Inform the Liaison Physicist about all changes to the experiment. He will know if further review is needed. In addition to keeping the C-A informed, you should share knowledge about the rules with all members of the collaboration. For example, all Users should be aware of any local actions to be followed in response to a hydrogen alarm or a fire alarm. Users should be aware of the hazards associated with protective systems such as halon fire protection. They should know of hazards associated with the experimental equipment such as vacuum windows, enclosed spaces or pressurized devices. Additionally, Users should be aware of the harmful nature of any hazardous materials in use.

Should Users assume the safety committees have made the experiment safe, or should Users continue to minimize hazards?

It is preferable to engineer all hazards out of an experiment. The C-A Department safety review committees try to ensure that safe or acceptable configurations are planned. In some cases, the plans are not followed or subtle hazards appear after the experiment is built. Common problems that arise after review of an experiment are:

1) bottled gases with suitable pressure do not have two-stage regulators,

2) flammable gas lines are not properly supported or labeled; plastic is used between the regulator and the flow limiter even though metal lines are required,
3) more than a reasonable supply of flammable gas is stored inside the experimental halls,
4) gas cylinders are improperly secured,
5) cable trays are used as tables or work surfaces, and
6) wood and plastic packing materials are stockpiled in or around the beam line.

If you feel some area or apparatus or practice is not safe, then say so. The C-A management will back you up and investigate.

Are there special permits required to emit gases from detectors?

The C-A has been reviewed for air-permit release-points by New York State. Prior to each experiment, the C-A Experimental Safety Review Committee and the Liaison Physicist must review the gas flows for all the detectors. For any release, the Liaison Physicist must submit a completed Effluent Evaluation Form in order to check the need for a permit.

LIST OF ACRONYMS

AGS - Alternating Gradient Synchrotron
ALARA - As Low As Reasonable Achievable
BNL - Brookhaven National Laboratory
BSA – Brookhaven Science Associates
C-A – Collider Accelerator
DEC - Department Emergency Coordinator
DOE - United States Department of Energy
EP&S - Experimental Planning and Support
ES&F – Experimental Support and Facilities Division
Division, a Division of the AGS Department
FEB - Fast Extracted Beam
HP - Health Physics
LEC - Local Emergency Coordinator
LOTO - Lock Out Tag Out
MCR - Main Control Room
OC - Operations Coordinator
ODH – Oxygen Deficiency Hazard
OSHA - United States Occupational Health and Safety Administration
PAAA – Price Anderson Act Amendments
RCD – Radiation Control Division
RCT- Radiological Control Technician
RHIC - Relativistic Heavy Ion Collider
RWP - Radiation Work Permit
SEB - Slow Extracted Beam
SRD - Self-Reading Dosimeter
TLD - Thermo-Luminescent Dosimeter